McGraw-Hill Publishing Company, Inc.
James H. McGraw, *President*
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American Machinist

Editors
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Volume 67 | New York, December 8, 1927 | Number 23

Electroplating Methods in the Gillette Razor Plant

By Floyd T. Taylor
Vice-President, A. P. Munning & Company

Present layout designed to finish 150,000 complete razors and accessories per day—Conveyor-type plating machines with time-cycle control are featured—Plating barrels also used

ALTHOUGH the Gillette Safety Razor Company's product is unique, the same general layout as installed in its new Boston plant can be applied to any kind of plating of practically any size of article in any volume of continuous production. For this reason it was selected as an example of modern electroplating methods. Furthermore, the inspection requirements of this company are so high that this installation illustrates production electroplating at its best.

One of the products made is the razor holder, consisting of five separate pieces, assembled after plating to three parts, called the guard, the cap and the handle, all made of special brass and all polished and electroplated with gold, silver or nickel as desired for the final finish. Other plated articles made are the metal razor boxes, blade boxes, soap boxes, surgical knife handles, chiropodist's chisel handles, carpet pile wires, textile edges, string cutters, and an office knife. Although the product is diversified, the plating operations are identical.

Before the present plating installation is described, it would be well to review developments of this work up to the present time. In 1902 the Gillette Co. rented a loft and installed a polishing and plating department in it. The department had a large surplus capacity but had to be enlarged a year later to what was then considered a model plant. The total power was supplied by a 5-hp. motor which served buffs, scratch brushes, and the plating dynamo. Two small silver plating tanks, a crock for gold, and the necessary auxiliary dips and rinses completed the equipment. All the plated parts were hand burnished after plating with the familiar bloodstone burnishers. By using skilled labor and exercising extreme care, the company turned out a high-grade product.

The plating department was increased in 1907 to eight

Fig. 1—These plating racks, shown being loaded, each hold 100 pieces

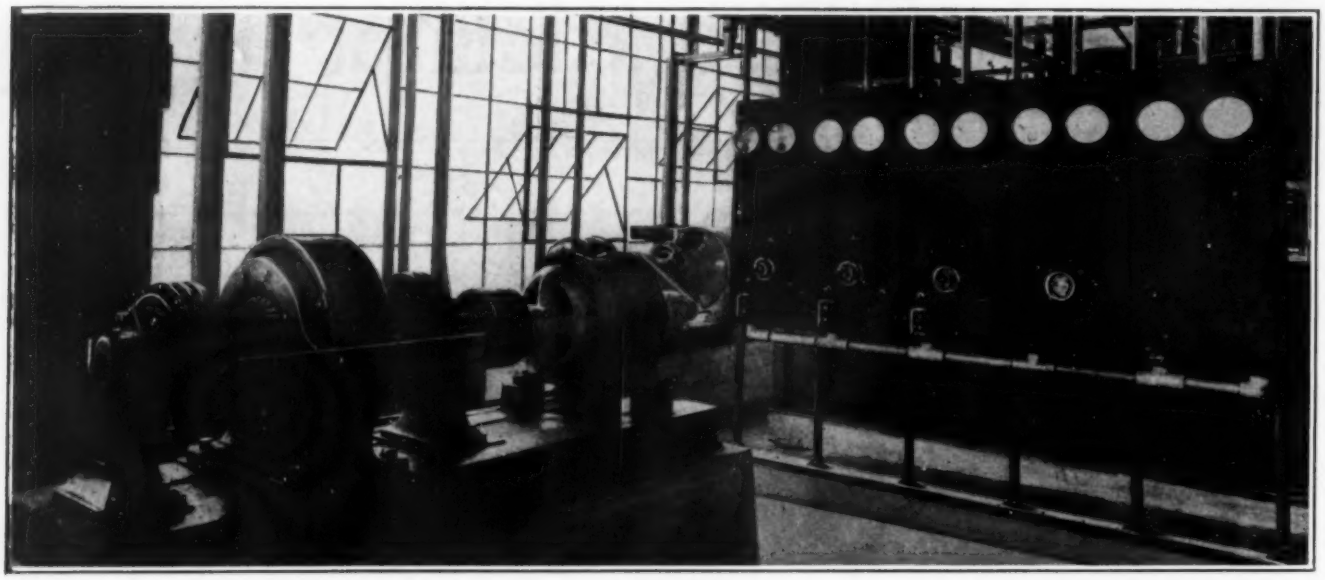


Fig. 2—The plating motor-generator sets and switchboard are installed in a glass-inclosed room ventilated from the outside

tanks, producing one thousand razors per day with a crew of four men to handle the work. In 1909 the plating room was enlarged again and bright silver solution tanks installed to eliminate some of the hand burnishing. It was not until 1915 that the first attempt at automatic control was made through the installation of Sangamo meters. Two years later Government orders forced production from four thousand razors per day to thirty-five thousand, making one hundred seventy-five thousand separate pieces to be plated. To care for this production, twenty-four nickel tanks of 150 gal. each were installed. There were then sixty-five men and seventy-five girls in the department.

After the war, the demand grew steadily and again changes were made to keep up with the production requirements. The old wiring system, which accommodated only five pieces to a wire, was replaced by racks, Fig. 1, which held one hundred parts, thus saving a large amount of time and labor. Semi-automatic plating tanks of the conveyor type were installed for nickel and silver plating and plating barrels were installed for the smaller razor parts. In addition, automatic cleaning processes were also adopted. However, none of these improvements were adequate. The mere expansion of tank capacity in the shape of semi-automatic conveyors did not solve the problems of uniformity, continuity of production, space, or labor. In order to take care of seventy-five thousand complete razors a day and a corresponding number of metal cases and miscellaneous parts in nine hours, or one hundred and fifty thousand complete razors and accessories in twenty hours per day, the Gillette engineers designed the present layout after considerable time and study. The maintenance of quality was paramount.

The polishing of the various pieces composing the razor handle is done on automatic machines developed by the company. For cutting down, tripoli is employed and for final coloring rouge is used for gold and silver, and lime for nickel. Burnishing, when required, is done by rolling on polished steel plates. The polishing is all done in a separate department entirely distinct from the plating division.

The new plating room occupies the top floor of the nine-story concrete addition to the Gillette plant. Endless belt and ladder-type chain conveyors deliver the work to the plating room from the floors below.

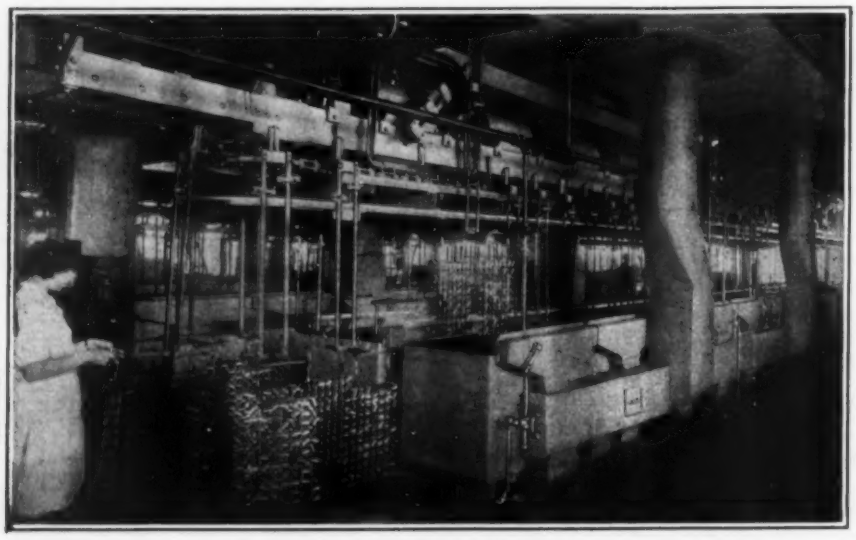


Fig. 3—One of the full-automatic conveyor-type plating machines in operation in the new Gillette plant

Electric current for plating is furnished from motor-generator sets consisting of Munning Optimus generators driven by General Electric induction motors. These sets are installed in a separate glass-inclosed room, ventilated from the outside. The switchboard containing the starting compensators, meters, and generator field regulating rheostats, is also mounted in this room, as can be seen in Fig. 2. Flat copper bus bars in strips mounted on edge and separated for ventilation, carry the current to the electrified tanks. The copper section is distributed on the basis of 500 amp. per sq.inch.

Automatic voltage-regulating relays control the separately-excited, shunt-type generators that supply current to the gold, silver and nickel conveyor plating tanks. Hence the drop from

anode to cathode of these tanks remains constant at any desired value regardless of the load in the tank. These regulators prevent burning of the work and make it possible to secure a uniform current density. Separate tank-regulating rheostats of the parallel coil type, each furnished with a voltmeter and ammeter, are installed on all other plating tanks.

The complete list of motor generator sets and the application of each is as follows:

Rated Amperes	Rated Voltage	Apparatus Supplied
1,000	12	Direct electric cleaner
2,000	6	Reverse electric cleaner and plating barrel
2,000	4½	Nickel conveyor-type plater
1,500	3	Silver conveyor-type plater
300	6	Gold conveyor-type plater

All parts requiring either wiring or racking are cleaned, rinsed, bright dipped, rinsed, plated, rinsed and dried on full-automatic continuous chain conveyors of the type made by the Munning Co. There are three of these plating machines for gold, silver and nickel, respectively. In general they consist of a continuous overhead chain conveyor, supported from the ceiling and mechanically independent of the tanks they serve. More specifically, the conveyor consists of a single roller chain driven by cut sprockets. This chain is provided with suitable projecting pins on which the work hangers ride. On the lower end of the work hangers copper cross arms are attached, and these cross arms support the racks containing the work which is thus carried through the solution.

Transfer mechanisms are used to lift the racks out of one tank and place them in another. These transfers consist of a rotating radial arm having a sliding crosshead, the end of which is constrained to move in a continuous steel channel. The arm is driven synchronously with the conveyor chain. This sliding crosshead carries a stud, one end of which is fitted with a roller bearing that engages the channel guide, while the other end of the stud lifts the work hanger off the conveyor chains, carries it over the tank partitions (quickly in relation to the movement of the chain) and replaces it on the same chain, but considerably in advance of its former position. The conveyors are driven by direct-connected motors through suitable gearing. In Fig. 3, one of these conveyors is shown in operation.

All the tanks are made of ¼-in. steel plate, riveted and double welded. The tanks carrying acid solutions are lined with 15-lb. chemical lead. The tank for the gold solution is glass lined and jacketed for hot water heating. The length of each tank is calculated with reference to the rate of travel of the conveyor and in accordance with its time cycle.

Before detailed figures on time cycles are given on each of the conveyor units, two of the less familiar terms will be explained. In the direct electric cleaner, the work is the cathode, and when an electric current is passed, hydrogen gas bubbles released at the cathode assist mechanically in the removal of the grease and other foreign matter by agitation and peeling action. Saponification is caused by the solution itself, when an alkali cleaner is used. While this process is largely mechanical in action, the reverse electric cleaner, on the other hand, is electrolytic to the extent that the oxide formed after polishing and before plating is stripped off by a de-plating action.

For gold plating the standard time cycle is as follows:

1—Load	
2—Hot soak	11½ min.
3—Hot rinse and spray	38 sec.
4—Electric cleaner	5 min.
5—Reverse electric cleaner	38 sec.
6—Cold rinse and spray	38 sec.
7—Cyanide dip	38 sec.
8—Cold rinse and spray	12⅓ min.
9—Cold rinse and spray	38 sec.
10—Gold plate	4½ min.
11—Gold rinse (Reclaim)	1 min.
12—Cold rinse and spray	38 sec.
13—Hot rinse and spray	38 sec.
14—Dry by hot air	5 min.
15—Unload	

The principal dimensions of the conveyor are:

Center to center of work hangers	16 in.
Normal chain speed per minute	11 in.
Height of lift	28 in.
Total length of tanks on floor (approx.)	49 ft., 5 in.
Total width of tanks (approx.)	6 ft., 6 in.
Headroom required	10 ft.

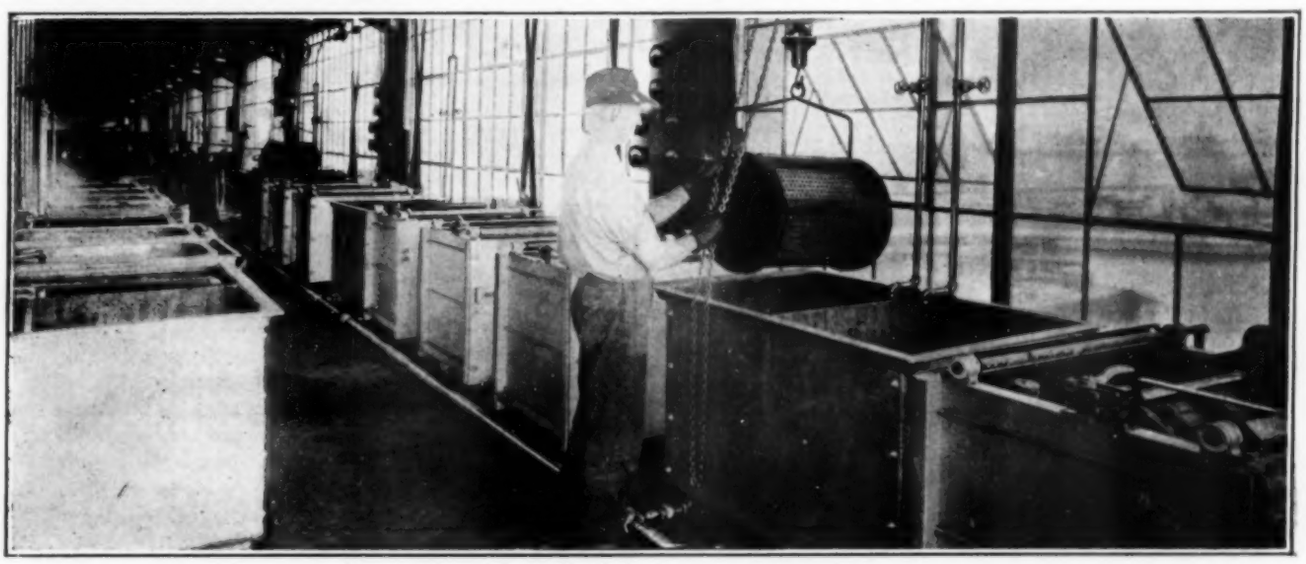


Fig. 4—Battery of silver and nickel plating barrels

The silver plating conveyor is novel in that a single overhead chain conveyor serves two parallel sets of tanks so that both bright and dull silver plating can be done on a single machine depending merely on whether the racks are hung on the inside or outside end of the work hanger cross arm. The standard time cycle for bright silver plating is:

1—Rack	———
2—Hot soak	9⅔ min.
3—Hot rinse and spray	28 sec.
4—Direct electric cleaner	3½ min.
5—Reverse electric cleaner	24 sec.
6—Cold rinse and spray	24 sec.
7—Cyanide dip	24 sec.
8—Mercury dip	24 sec.
9—Cold rinse and spray	44 sec.
10—First silver strike	24 sec.
11—Second silver strike	1½ min.
12—Cold rinse and spray	3⅔ min.
13—Silver plate	30 min.
14—Cold rinse and spray (reclaim)	24 sec.
15—Cold rinse and spray	44 sec.
16—Hot rinse and spray	24 sec.
17—Unload	———

The standard cycle for dull silver plating is:

1—Rack	———
2—Hot soak	9⅔ min.
3—Hot rinse and spray	28 sec.
4—Electric cleaner	3½ min.
5—Reverse electric cleaner	24 sec.
6—Cold rinse and spray	24 sec.
7—Cyanide dip	24 sec.
8—Cold water	24 sec.
9—Cold rinse and spray	44 sec.
10—First silver strike	24 sec.
11—Second silver strike	1½ min.
12—Cold rinse and spray	3⅔ min.
13—Silver plate	39 min.
14—Cold rinse and spray (reclaim)	24 sec.
15—Cold rinse and spray	44 sec.
16—Hot rinse and spray	24 sec.
17—Unload	———

The principal dimensions of the conveyor are:

Center to center of work hangers	16 in.
Normal chain speed per minute	15 in.
Height of lift	28 in.
Total length of tanks on floor (approx.)	51 ft., 1 in.
Total width of tanks (approx.)	6 ft., 6 in.
Headroom required	10 ft.

The nickel plating conveyor is based on the following time cycle:

1—Rack	———
2—Hot soak	10 min.
3—Hot rinse and spray	36 sec.
4—Electric cleaner	3.5 min.
5—Reverse electric cleaner	36 sec.
6—Cold rinse and spray	21 sec.
7—Cyanide dip	21 sec.
8—Cold rinse and spray	21 sec.
9—Cold rinse and spray	3 min.
10—Nickel plate	15 min.
11—Cold rinse and spray	21 sec.
12—Hot soap dip	21 sec.
13—Hot rinse and spray	21 sec
14—Dry by hot air	3⅔ min.
15—Unload	———

The principal dimensions of the nickel plating conveyor are:

Center to center of work hangers	16 in.
Normal chain speed per minute	20 in.
Height of lift	28 in.
Total length of tanks on floor (approx.)	53 ft., 1 in.
Total width of tanks (approx.)	6 ft., 9 in.
Headroom required	10 ft.

Beside the conveyor section there is a group of plating barrels with cleaning and rinsing tanks needed for barrel plating. This group is served by a simple monorail hoist crane. It is divided into two sections so that the large size machines for silver and nickel plating together with their cleaning, rinsing and dipping tanks and dryers, is separated from a similar group of jeweler-type plating barrels and auxiliary equipment for the parts plated with gold in plating barrels.

Six single-cylinder Munning Optimus type E-20 plating barrels are used for silver plating and two similar machines do the nickel plating while two jeweler's plating machines take care of the gold plating. Batteries of silver and nickel plating barrels are shown in Fig. 4. The Munning-type barrel is hexagonal in form and features a patented self-drenching panel. The panels are inset so as the cylinder revolves the pocket thus formed continuously dips up the solution and pours it through the perforated panels into the interior of the drum, thus keeping the metal content of the solution within the cylinder, where the plating is going on, the same as it is near the soluble anodes. The barrel framing is made of solid mahogany, unpainted, and it revolves upon a solid copper cathode rod as an axis. Jointed danglers of copper rod, free to turn about the cathode rod, form the connecting electrical link between the work and the cathode rod itself.

As regards the material, gold anodes assaying 24 carats are used. For silver the anodes are 999 fine, and for nickel plating 99.9 per cent electrolytic nickel is used.

Lacquering of gold and silver razors is done on a ladder chain dip lacquering machine located three floors below the plating room.

Another feature of the Gillette layout is the acid handling equipment. The sulphuric acid used in the plating room is stored in a tank located in the street from which it is pumped by an air-lift pump to the plating room on the ninth floor into a reserve tank from which it is drawn.

What Modern Equipment Has Done

BEGINNING WITH AN EARLY ISSUE of the new year there will be published, at intervals, a series of articles under the title given above. This group will be a sequel to the series "Getting the Most Out of Your Machine Tool Dollar." Policies and practices of buying, using and disposing of shop equipment were the themes of the former series. The new series will tell of actual results obtained by replacing obsolete with modern equipment. Some of the achievements to be shown will be startling, to say the least. The alert equipment user will read and profit by these articles.

A Management Chart That Talks

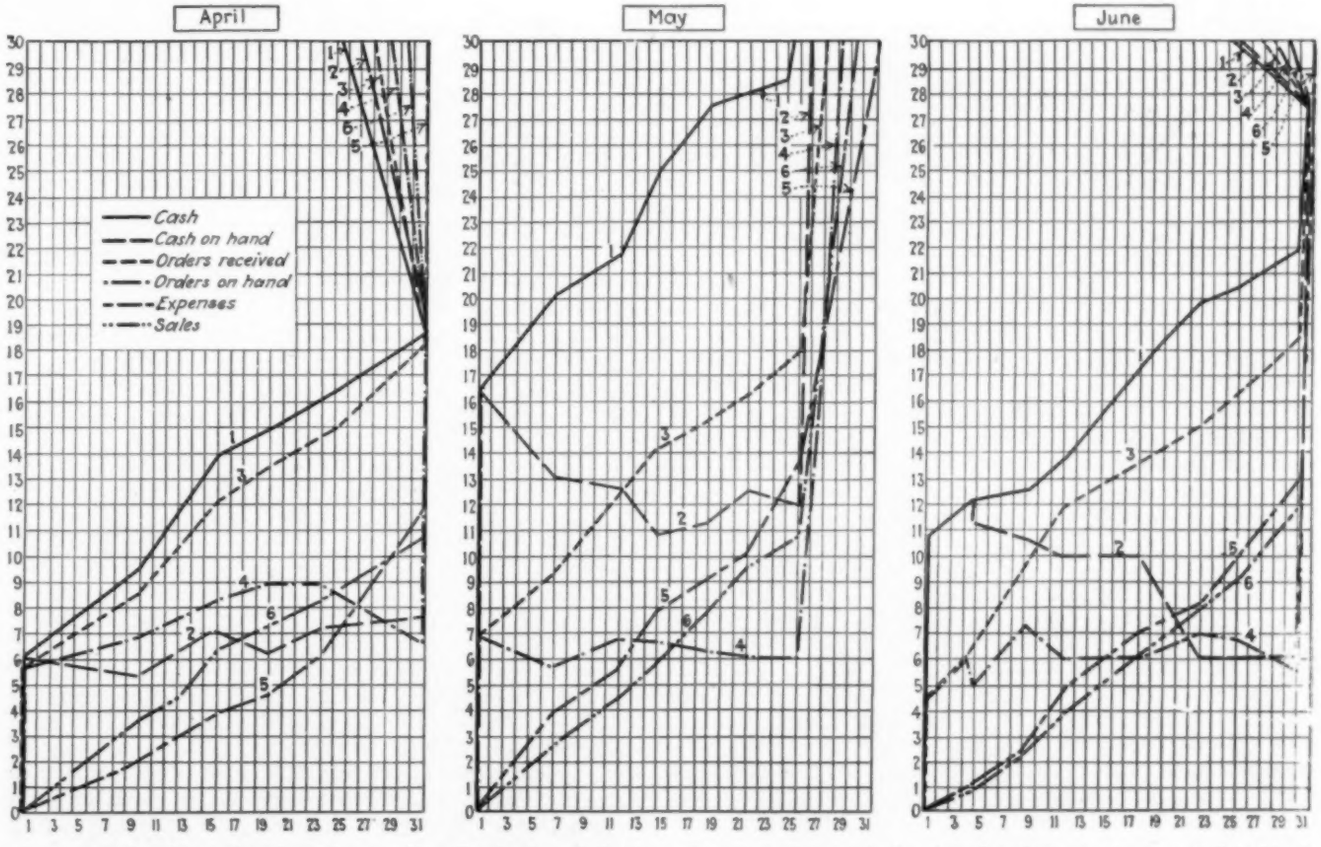
By Ellsworth Sheldon
New England Editor, American Machinist

"EVERYBODY knows your business" is considered an asset at the plant of the Bantam Ball Bearing Co. In the manager's office there is hung on the wall a large, framed, white chart, on which is kept a detailed record of the higher functions of management, such as records of orders, shipments, expenses, and collections. This is open to the inspection of production, sales and engineering supervisors, who can consult it at any time. In the superintendent's office is another similar chart, carrying the records of production and shop expense, which is in turn open to the inspection of the shop. By means of these charts, the management is able to follow closely the important features of the business. But of major importance, also, is the fact that the publicity given to the higher aims of the management gets away from some of the drabness of every-day production, and creates more co-operation and harmony throughout the works.

The manager's chart is shown in the accompanying illustration. The figures at the left-hand side of the chart represent thousands of dollars, those at the bottom representing the days of the month. The three charts in the large frame represent three successive months of the year.

From the upper right-hand corner of each division of the chart hangs six colored silken cords. The red cord indicates expenses incurred, the black cord indicates shipments or sales, two blue cords are used for orders on hand and orders received, and two yellow cords are used for showing cash on hand, cash received, and disbursements. On the first day of the month the cords are pulled down and hooked on the zero pin at the lower left-hand corner of the division. On the first of the month a report comes in showing bills receivable, bills payable, cash on hand, and orders on hand. This report is submitted by the financial and bookkeeping departments. A square red pin is placed on the first vertical line, showing almost exactly how many thousand dollars of bills payable there are, and a square black pin is placed on the same line to show the bills receivable. In the same manner, a round yellow pin is placed on the same line at the proper height to indicate the cash on hand. The colored cords are lifted to rest on the respective pins.

At the end of the first week another slip comes in from



A manager's chart showing the condition of important features of the business. The various cords are colored. Cords 1 and 2 are yellow in color and show cash on hand and cash received, 3 and 4 are blue and show orders on hand and orders received, and 5 is black and indicates shipments, while 6 is the expense curve with a red cord

the financial department, and in addition to the cash and orders on hand, there is cash received, orders received, shipments for the week, and expenses for the same period, with pro-rated salaries, wages, and operating burdens included. The cash received is added to the cash on hand on the first of the month, and a yellow pin placed on the vertical line on the sixth day, showing the total. Another yellow pin is placed on the same vertical line, showing the cash on hand on this date. Here is where the two yellow cords divide, one going upward to the right, showing the flow of cash inward, and the other going horizontally or downward, showing the flow of cash outward. The blue cords following the blue pins used in connection with orders on hand indicate in a similar manner the flow of orders in and the balance of orders on hand. In a similar manner, the black cord and the red cord indicate in dollars the shipments and the expenses incurred.

The clerical work of charting the progress continues during the month at intervals of three days and one week. The manager and other executives have before them a continuous record of progress in the important functions of the business. If the money-received line begins to drop, it indicates that collections are not up to standard, and that the credit department needs attention. At the same time, the blue line shows to all the efficiency of the sales end of the business, and also how the production department is getting rid of the orders coming in. In the upper left-hand corner of the frame there is also a smaller chart, not shown here, on which is shown by a system of colored pins the month-to-month condition of cash, orders, shipments and expenses throughout the year.

Electrolytic Stripping of Dip-Brazed Parts

By T. W. Downes

Associate Metallurgist, Naval Aircraft Factory

IN MOST cases it is desirable to remove the excess brass from dip-brazed parts. Usually this is done electrolytically, the part to be deplated being made the anode. Although apparently not generally known, a water solution of sodium nitrate of commercial purity constitutes an inexpensive but effective electrolyte for this purpose. Steel parts dip-brazed in the ordinary way are satisfactorily cleaned of brass, except for adhering lumps, in ten to fifteen minutes in a solution made up in the ratio of three ounces of sodium nitrate to one quart of water, using six volts. An added advantage in using this solution is the fact that brazed-steel parts show no unusual tendency to rust after deplating, whereas with certain other electrolytes precautionary measures must be taken to prevent rust.

With any voltage that will deplate, the brazing brass will be removed from the joints at the edges of parts brazed together if sufficient time is allowed. Removal of the brass proceeds inward in direct proportion, roughly, to the time. Tests have shown that in fifteen minutes, with six volts and a current density of one and one-half amperes per sq.in., the brass is removed for a distance of about 0.02 in. inward from the edge of a brazed joint, and that in two hours the brass is removed to a depth of about $\frac{1}{8}$ in. Ordinary coatings of brass, however, can be completely removed from brazed steel before serious attack has been made at the joints. This can usually be accomplished in about ten minutes, or in fifteen minutes if the coating is unusually thick, using the voltage and current values mentioned above. Adhering lumps of brass, of course, require longer for their removal.

There is no apparent embrittling or weakening of steel specimens due to stripping of brass therefrom by electrolytic means. The tensile strength of specimens was found to be about the same after stripping as before, even when electrolyzed for three hours at 6.5 volts in the sodium nitrate electrolyte. Also after this treatment, specimens of S.A.E. No. 1025 steel $\frac{1}{16}$ in. thick, bent 180 deg. over about $\frac{1}{32}$-in. radius without sign of rupture.

The use of paraffine as a protective against deplating is satisfactory under certain conditions. The electrolyte must not be allowed to reach a temperature much over 100 deg. (38 deg. C.) as the melting point of paraffine is from 113 deg. to 176 deg. F. (45 to 80 deg. C.) according to its composition. It functions most satisfactorily when applied in a thin layer. This may be accomplished by warming the article to about 100 deg. F. and either dipping the parts to be coated in melted paraffine, or by applying melted paraffine with a small brush. If the article is not previously warmed, the paraffine adheres too thickly and has a tendency to peel off during deplating.

What Is Naval Aviation Doing?

By Captain E. S. Land

WHEN commercial aviation was wallowing in the slough of despond, and when our airplane constructors and engine builders were putting down more red figures in the account books than was pleasant to the stockholders, Naval aviation was carrying a very large share of the burden of keeping the best concerns going. This was done through active, earnest and financial efforts to co-operate with the trade in every practicable way. It was done by giving experimental orders, by aiding in experimental and technical development, and by such assistance, both technical and financial, as was warranted by the conditions existing at the time.

It was the Navy's policy to pave the way for extensive flights, particularly over water, and in this way a great deal of exploration and pioneering work was done, some of the benefits of which are now being reaped by commercial aviation.

While the Navy has gone out of the racing game, it is encouraging the development of extremely light engines, and wherever practicable, has given assistance in the way of technical advice, the use of special instruments, special charts, and the loan of expert personnel. A great deal of concentrated effort has been spent on the subject of standardization, this in co-operation with the army Air Corps. It has been of material assistance in developing hand starters and oleo, or hydraulic, shock absorbers for landing gears.

Abstract of a paper presented before the Society of Naval Architects and Marine Engineers, Nov. 10, 1927.

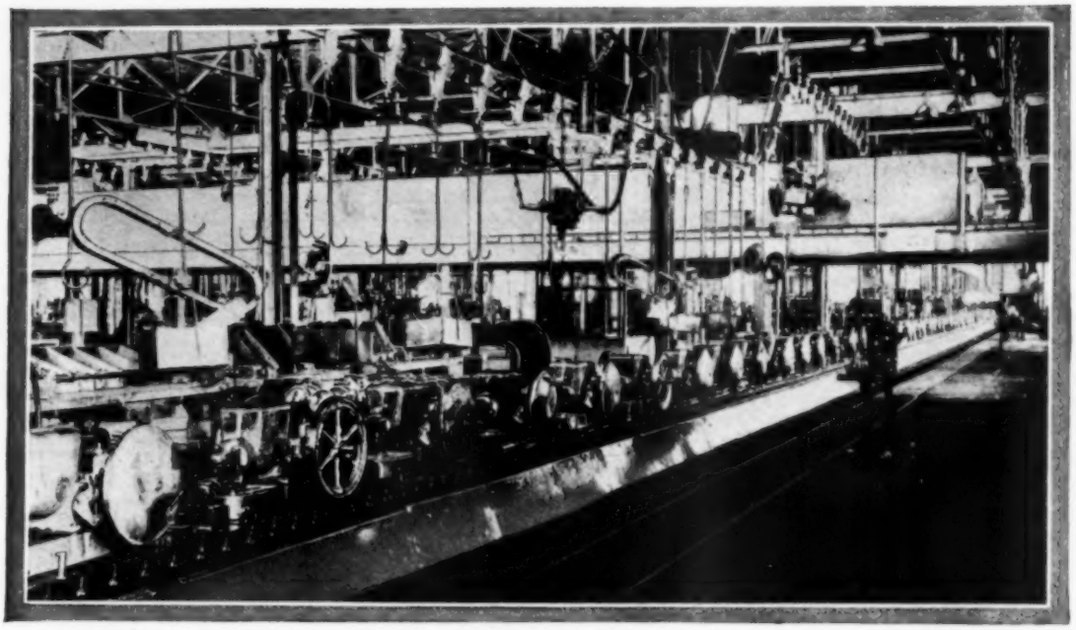


Fig. 1—Assembling 2-hp. Fairbanks - Morse gasoline engines on apron - type conveyor. Parts are supplied from balcony storeroom by an overhead conveyor. The engines are tested while traveling on the conveyor, the exhaust gases being carried away by a duct under the conveyor

Progressive Assembly in Industry

Photographs secured through the courtesy of
Frank L. Eidmann, School of Engineering, Princeton University

(*Continued on next page*)

Fig. 2—After the engines have been tested they are given a steam bath in preparation for painting. They are painted by an air-operated spraying machine as they are carried along on the conveyor

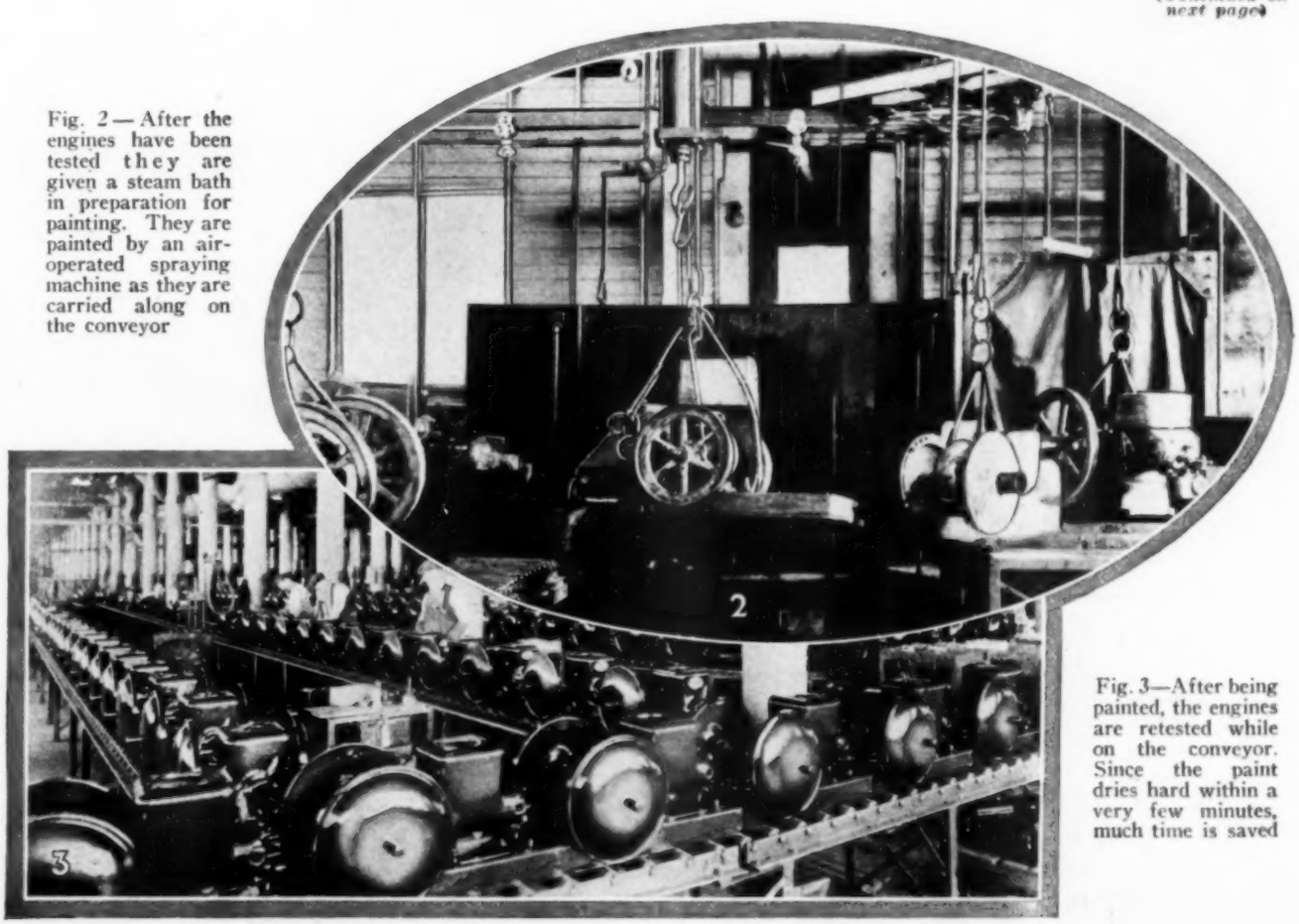


Fig. 3—After being painted, the engines are retested while on the conveyor. Since the paint dries hard within a very few minutes, much time is saved

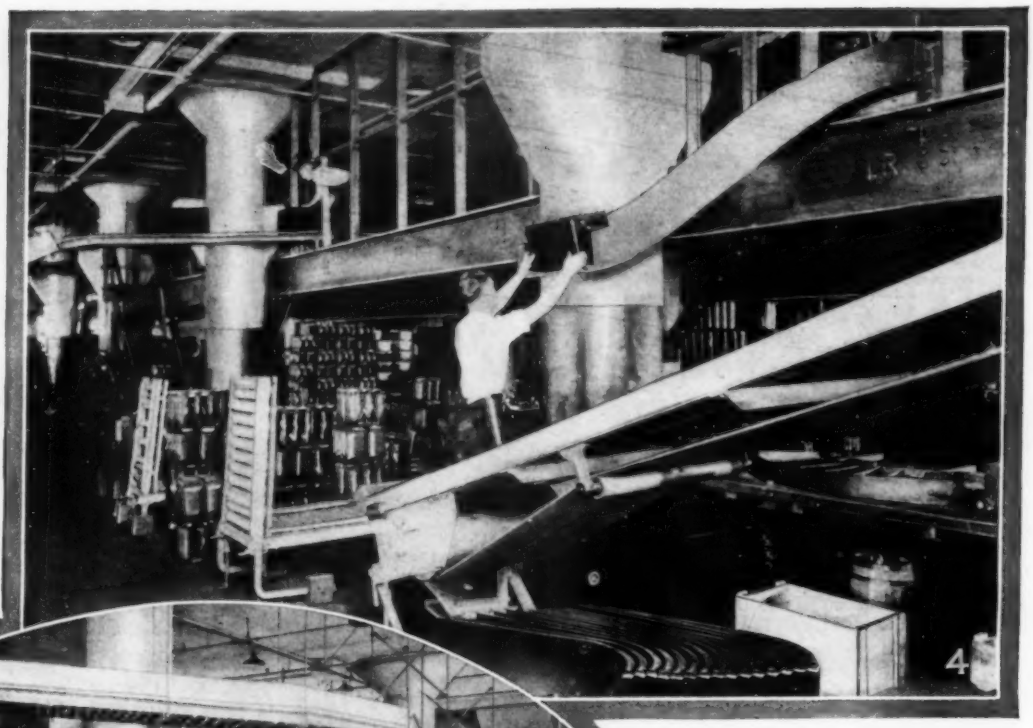


Fig. 4—Assembling compensators at the Bloomfield Plant of the General Electric Co. Various parts are stored on and under the mezzanine floor, and are handled by a gravity chute and an inclined belt-conveyor

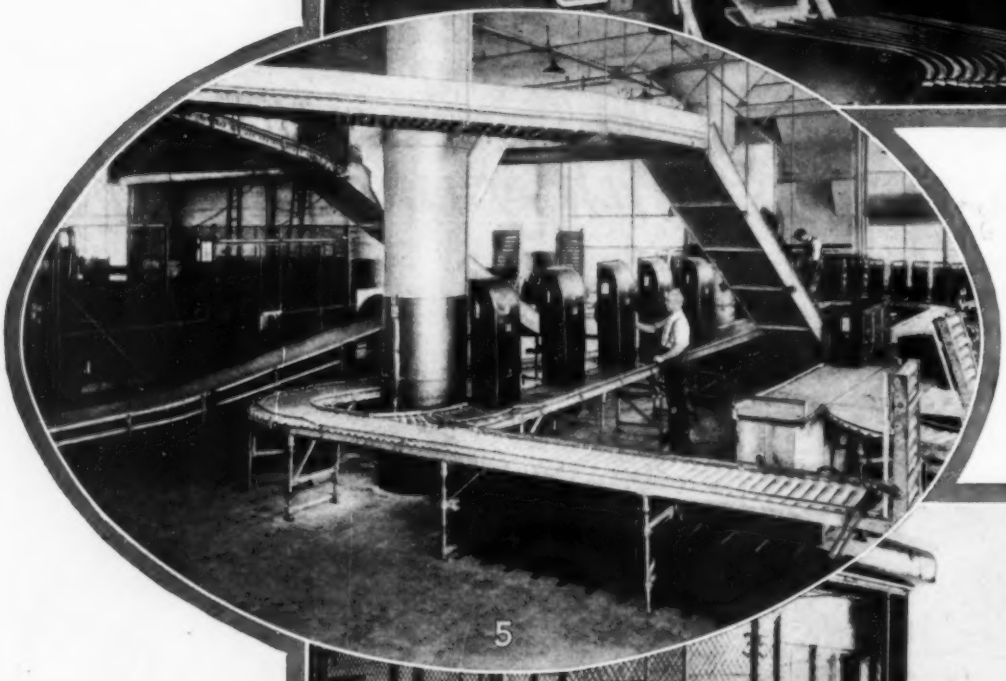


Fig. 5—Inclined belt and roller gravity conveyors for handling incoming parts for the last assembly of the compensators. The overhead conveyor transports parts to the switch department. Compensators are tested on insulated conveyors

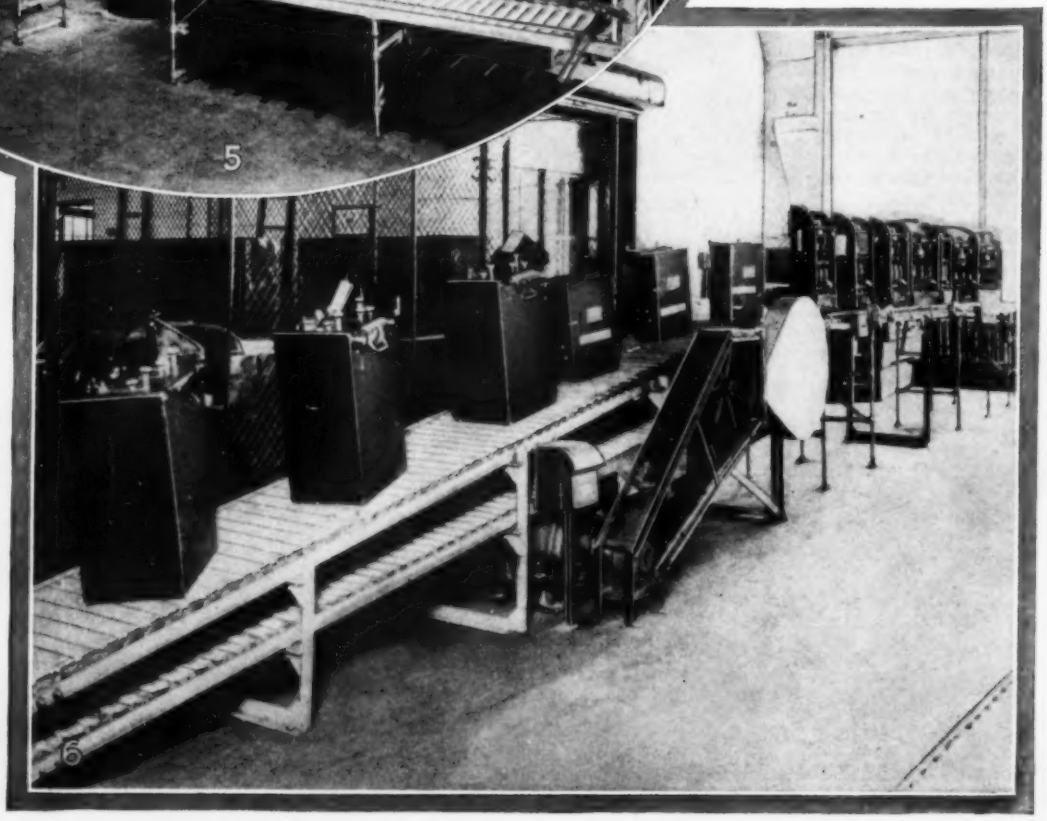


Fig. 6—The motor drive of a chain-slat conveyor. This conveyor is used to collect compensators from the test department and deliver them to the inspection department by way of a gravity conveyor, to which it rises

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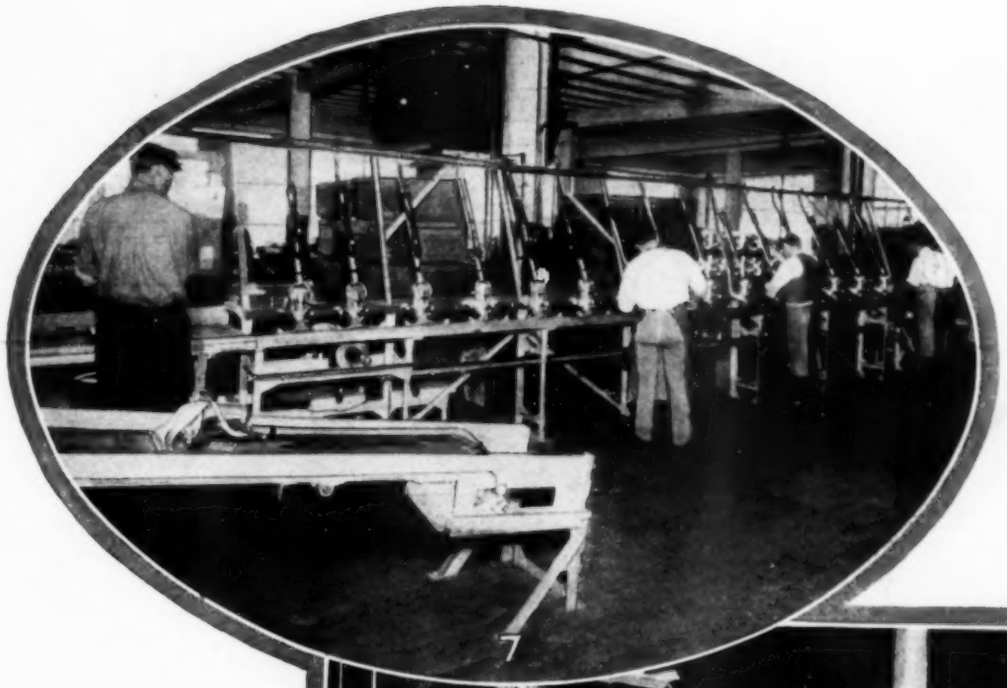


Fig. 7—Assembling Eureka vacuum cleaners. Four men assemble as many cleaners on the conveyor aswere assembled by ten men before the conveyor was installed. The construction of another building was rendered unnecessary by the installation of the conveyor system

Fig. 8—The cleaners are inspected as they are carried along past the men. The upper belt against which the handles of the cleaners rest, travels at the same speed as the belt on the inspection bench

Fig. 9—After the cleaners have been inspected they are carried on an inclined belt-conveyor to the packing room on another floor

(Continued on next page)

Fig. 10—Assembling gas ranges on chain-belt conveyors. Here the men are assembling oven burners, shelves and other parts as the ranges travel

Fig. 11—Further along the line the man at the right assembles the gas manifold. The next operation is assembling the doors and is performed by the man at the left

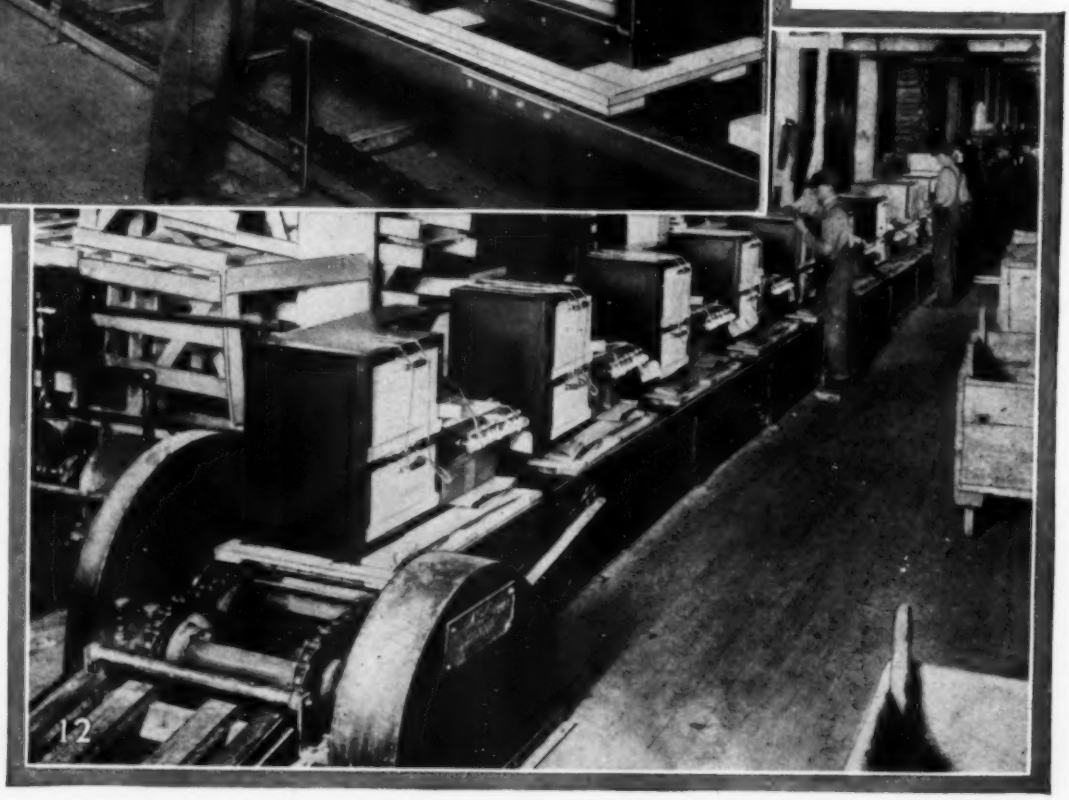


Fig. 12—On this conveyor the ranges pass before the inspectors. They are given a thorough inspection and are then passed along to the packing and shipping department

Protective Glasses for Gas and Electric Welding

By J. W. FORREST
Member of Scientific Bureau, Bausch & Lomb Optical Company

As a result of research, a glass has been produced that will absorb the injurious ultra-violet and infra-red rays outside the visible range of the spectrum

IN RECENT years, the development of sources of radiant energy of high power, and the application of these sources to the varied requirements of the industrial world has led to the necessity for greater protection for the eyes of the operator. Probably the greatest single application of open sources of high intensity is in arc welding. This article will refer particularly to that branch, since the nature of the problem in other fields is essentially the same.

It is a well-known fact that an open source such as an arc or furnace sends out an immense amount of radiant energy, the extent of which is far above and below the visible range. What is meant by energy "above and below the visible range" can be explained in a few words. We are all familiar with the visible energy spectrum, extending from red to violet. This, however, constitutes an exceedingly small portion of the total energy spectrum. The extreme red visible to the normal eye has a wave length of about 750 μμ (micro-millimeters) and the extreme violet a wave length of about 400 μμ. To all wave lengths within this limited range, the normal retina is responsive. Below the red lies another portion of the total energy output of greater wave length which, while not visible, is capable of serious effect on the visual organs. Beyond the violet lie the shorter wave lengths, also invisible, but still capable of seriously affecting those portions of the eye to which they can penetrate. A simple table will serve to distinguish the various portions of the energy spectrum mentioned above and to show their approximate extent.

Designation	Wavelength in Micro-millimeters
Short ultra violet	315 and below
Long ultra violet	315 to 400
Visible	400 to 750
Short infra-red	750 to 1,250
Long infra-red	1,250 to 100,000

The characteristics of the human eye with respect to different wave lengths are approximately as follows:

(a) All the media of the eye are transparent to those wave lengths within the visible range

(b) The cornea absorbs all wave lengths shorter than about 300 μμ

(c) The crystalline lens absorbs completely at 350 μμ

(d) All the media are transparent to the radiation from white-hot bodies (short infra-red) and opaque to radiation from red-hot bodies (long infra-red).

As will be seen, the interior of the eye and particularly the retina is protected from the ultra violet by the strong absorption of the cornea and the lens. One would expect then to find that this type of radiation would have its effect on the outer portions of the eye. Such is the case, as it has been found that continued exposure to strong ultra-violet light brings a great amount of pain and discomfort in the form of inflammation of the cornea and conjunctiva. It may also produce complete corneal opacity. The effects resulting from such exposure are immediate and very noticeable. They will usually yield to treatment, unless the cornea has been permanently injured.

The effect of visible energy lies, of course, in the blinding and fatiguing effect on the retina to which it can penetrate without obstruction. The short infra-red waves, which also pass through the media without much absorption, have an effect that is not noticeable as the effect of the ultra-violet waves, but is probably more dangerous in that it is more likely to be permanent. It has been definitely established that continued exposure to such radiation can result in the following injuries to the eye: Formation of cataract, permanent damage to the retina and choroid, or clouding of the aqueous. All these injuries, of course, lead to impaired vision or total loss of sight. Other injuries are possible, but mention of these three will show how necessary complete protection is.

The energy given out by a high-intensity welding arc, for instance, embraces all the types of radiation mentioned above and, consequently, the operator must be provided with glasses, whose absorption is very carefully worked out, if he is to be kept from permanent injury to his eyes. Until quite recently, it has been customary to assume that, if the visible rays were cut down to a comfortable intensity, the ultra-violet and infra-red rays were also reduced proportionately. The usual practice was to use alternate layers of red and blue glasses in sufficient quantity to reduce the intensity to a value consistent with the work being done. Such a procedure may or may not offer complete protection since some glasses strongly absorb visible rays and yet transmit infra-red or ultra-violet rays quite freely. Recent research has enabled the manufacturer to put on the market a glass that will, in varying thickness and densities, answer the three demands of a good protective glass; that is, it will have ultra-violet absorption great enough to eliminate com-

Typical Specifications for Protective Glasses

Shade No.	Per Cent of Rays Transmitted: Visible Rays 400-700 μμ		Infra-Red Rays Above 700 μμ	Ultra-Violet Rays 313	334	365	405
	Minimum	Maximum	Maximum	Max.	Max.	Max.	Max
3	14.0	18.0	9.0	0.2	0.2	0.5	1.0
4	5.0	8.0	5.0	0.2	0.2	0.5	1.0
5	1.2	2.4	2.5	0.2	0.2	0.2	0.5
6	0.5	1.0	1.5	0.1	0.1	0.1	0.5
8	0.15	0.30	1.0	0.1	0.1	0.1	0.5
10	0.005	0.015	0.6	0.1	0.1	0.1	0.5
12	0.001	0.004	0.5	0.05	0.05	0.05	0.1
14	0.0001	0.0005	0.3	0.05	0.05	0.05	0.1

pletely the external effects due to short wave radiation; visible absorption sufficient to take away glare and retinal fatigue; and infra-red absorption to prevent any retinal or corneal effect.

Various sets of specifications for welding glasses have been proposed. The differences between them are of a minor nature and for the purposes of this discussion may be neglected. Typical specifications for the various shades are shown above. A comparison with the accompanying graph will show what appear to be discrepancies. For instance, Shade 3 in the graph shows a maximum transmission at 570 μμ of 18.5 per cent, a figure in excess of the maximum permitted by the specification. This is due to the fact that the specification is made on the basis of white-light transmission, which, for this particular glass and shade, would be around an average of 16 per cent. The peak of the transmission curve will always show a higher transmission value than is given by a reading made in white light, because of the wide range of wave lengths in white light.

The general uses for which each shade of the above table has been designed is as follows:

Shade 3—Reflected sunlight from snow, sand, water, and other outdoor subjects

Shade 4—Pouring and furnace work

Shade 5—Light acetylene cutting and welding; light electric spot welding

Shade 6—Acetylene cutting and medium acetylene welding; arc welding up to 30 amperes

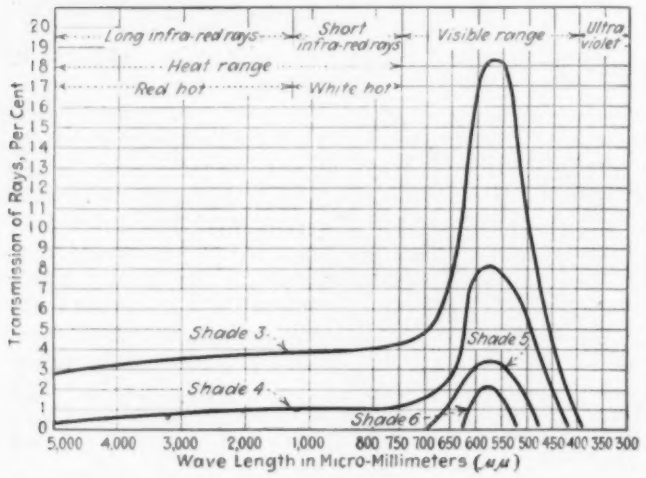
Shade 8—Heavy acetylene welding; arc cutting and welding between 30 and 75 amperes

Shade 10—Arc cutting and welding between 75 and 200 amperes

Shade 12—Arc cutting and welding between 200 and 400 amperes

Shade 14—Arc cutting and welding at 400 amperes and over.

In the graph is shown the transmission curve of a characteristic, good welding glass. The curves give the characteristic transmission of the first four shades, that is Nos. 3, 4, 5 and 6. The thickness would gradually increase as the absorption rises. For example, Shade 3 had a thickness of approximately 1.5 mm. and Shade 4 a thickness of 2.5 mm. It can be seen at once that it would not be practical to make shades all from a batch of glass of given density, since the extremes would become excessively thick or thin. This difficulty is overcome by varying the density of various batches so that the required shades can be obtained from different pots at a thickness of approximately 2 to 3 millimeters.



Comparative transmission of light rays of various wavelengths through recently developed shades particularly designed to limit ultra-violet and infra-red rays

What Should a Director Do?

By H. C. Wainright

SOME years ago the *American Machinist* ran an editorial referring to the fact that perhaps there were too many business men in this country. Times have not changed. When you look over the so-called business men directing the affairs of manufacturing concerns, and realize how little some of them know of the details of their business you wonder how some of them hold their jobs when they ought to be doing something for which they are better fitted.

If our concerns were managed by practical, hard-headed business men who knew the game from A to Z there would not be so much complaint, in the equipment industries, of "selling at cost." Whose fault is it that machine-tool builders are not getting enough for machine tools? Why don't they put up their prices to a point where they can make a fair return on the capital invested, and then stick? Why do they take in second-hand tools if they don't believe in it?

Much of the unnecessary overhead that has crept into business could be cut down by an efficient board of directors. How much does the average director know of the details of the business? He leaves the direction of the company to its officials, and rightly so, but he should be in a position to check up on their acts.

He could strengthen the backbone of the sales manager when that gentleman is tempted to shake prices for the benefit of a powerful customer. He could see to it that the production men be made responsible for production and given the type of machine tools and other equipment they want instead of having to take a substitute that could be bought by the purchasing agent at a lower price. He could insist that the purchasing agent consider himself as an important contact man for his company, the man from whose attitude it will be judged by the companies from which it purchases. He would see that sales efforts were concentrated on the most profitable markets.

When all directors reach this stage of efficiency most of the bad practices of business will vanish and life will be much more worth living.

Shop Methods of the Delaware & Hudson Company

By Fred H. Colvin
Editor, American Machinist

Holding fixtures for valve-chamber heads—Temporary main rods for setting valves—Methods for handling tires, steam pipes, and large sheets under the punch

SPECIAL fixtures for use in railway shops have to be designed and built as simply and economically as possible, on account of the limited number of pieces to be handled. On the other hand, the advantage of securing uniformity and of saving time in setting up the work makes it profitable to invest in some special devices, even though the number to be handled is not large. A good example of a very simple fixture that answers its purpose well, is shown in Fig. 12. Simply bolting the block *A* to the end of the guides on the valve-chamber head, makes it easy to hold the head in an ordinary four-jawed chuck, with the other end supported on the dead center. A counterweight on the chuck face prevents vibration when running at the proper turning speed and insures a smoothly-turned surface.

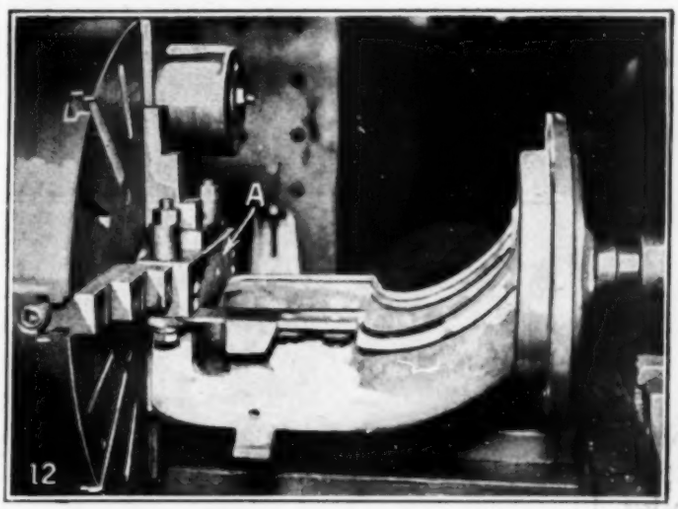
Before the valve chamber head is put in position on the locomotive, it is tested on the assembling stand, Fig. 13, and the valve-stem crosshead is tested for alignment with the guides. The test stand, as with many other stands in the shop, is of metal plate and is arranged for easy handling of the work.

Milling is being introduced in a number of operations, the channelling of connecting rods on a large Ingersoll machine being shown in Fig. 14. The method of holding the rods on the table can be plainly seen. The rods are located by large bolts through the holes in the ends, and the end thrust of the cutters is taken by the heavy angle plate across the end of the table. The rods are located sidewise by the screws at *A* and are held down by the heavy cross-bar *B*. The amount of metal removed can be judged by the chips in front of the cutters. This view also shows the pipes that carry the coolant.

The use of a double slotting tool is shown in Fig. 15, the work being the forked end of a radius link. The work is clamped in the usual way except that clamps *A* and *B* bear against the sides of the link to prevent the jaws from springing under the action of the tool. By using the double slotting tool and keeping it to size, both sides of the link opening can be machined at the one setting, and without changing the tool.

Piston rings are turned on a Bullard vertical lathe equipped with a special fixture for holding them. Fig. 16 shows how the bull-ring is held by clamps that grip the cored surface inside the large diameter of the ring. Similar fixtures are used for other work of this nature.

The second article. The third will appear in an early issue.



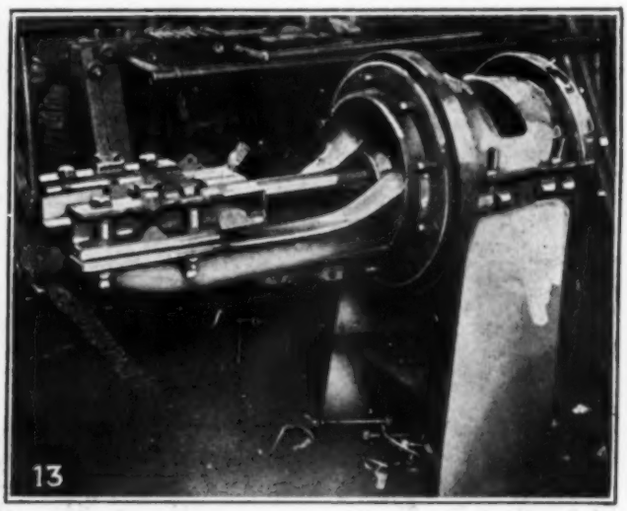


Fig. 12—Turning and facing the flange of a valve-chamber cover. A special block is bolted across the guides at the other end and is held in the four-jawed chuck. A counterweight on the chuck insures steady running of the work. Fig. 13—Fitting the valve-stem guide, with the valve-chamber cover held in a stand made of boiler plate. This method insures alignment before the head is put on the valve chamber. The stand is made of welded sheets

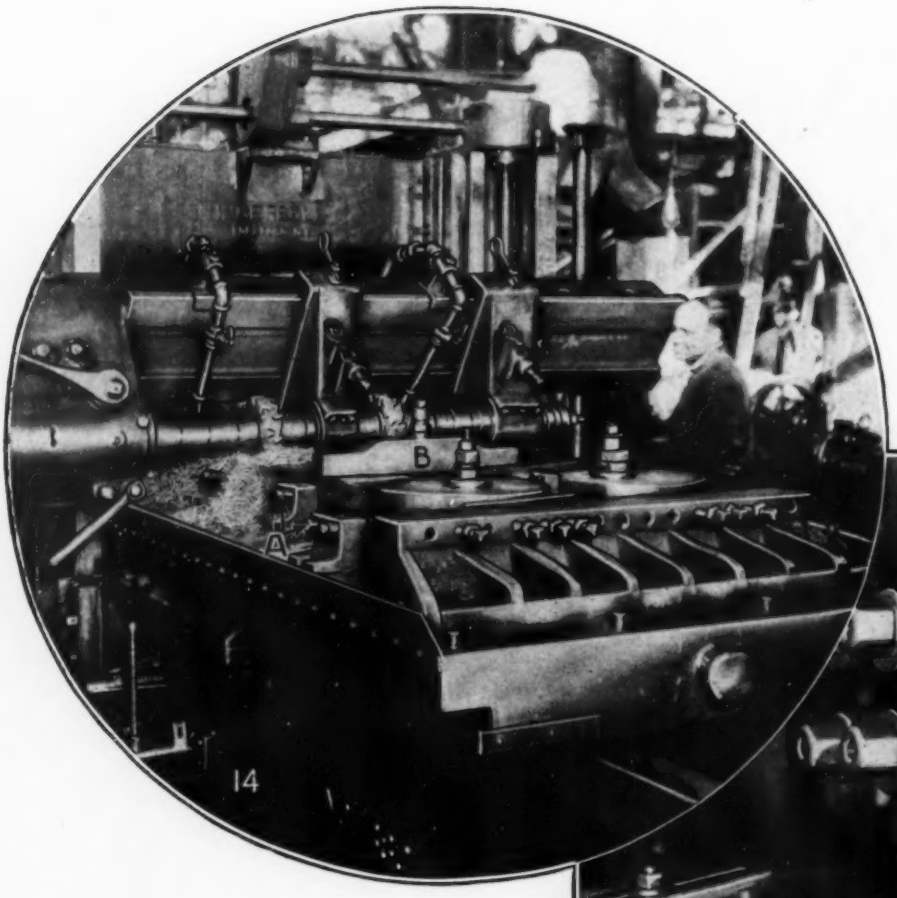


Fig. 14—Channeling connecting rods on an Ingersoll milling machine. Rods are located by bolts through the pin holes, while the end thrust is taken by an angle plate at the end of the table

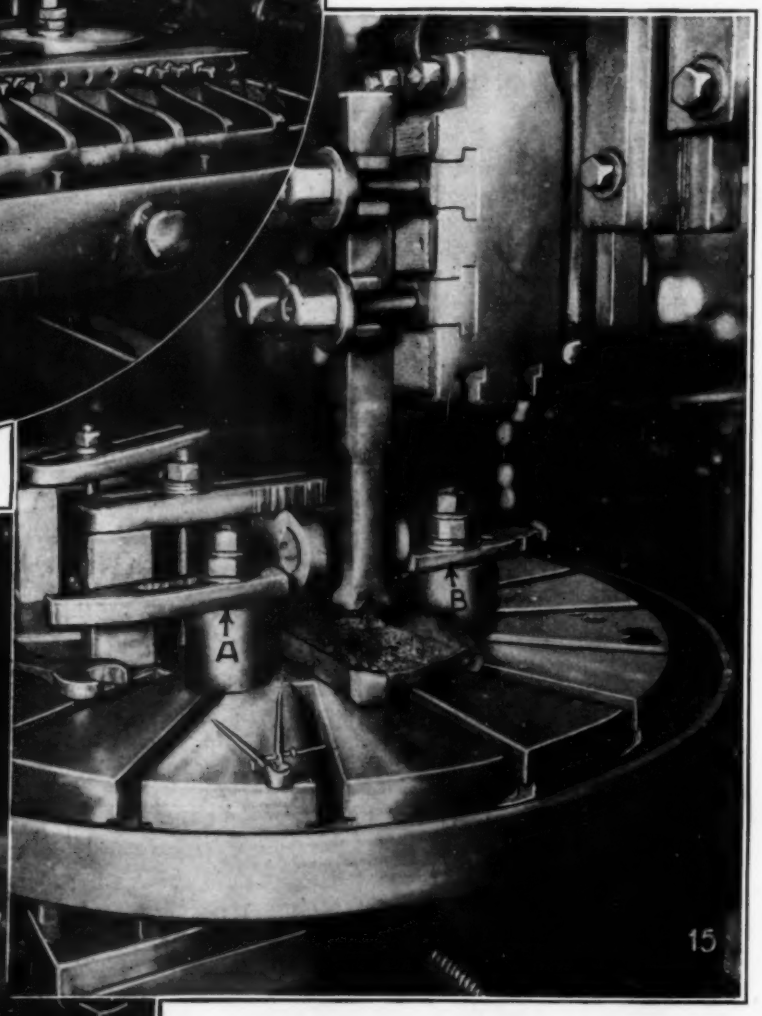


Fig. 15—Slotting both sides of a forked opening with a double slotting tool. Side clamps prevent the jaws from springing under the thrust of the tool. Chips are caught in the pan on the table

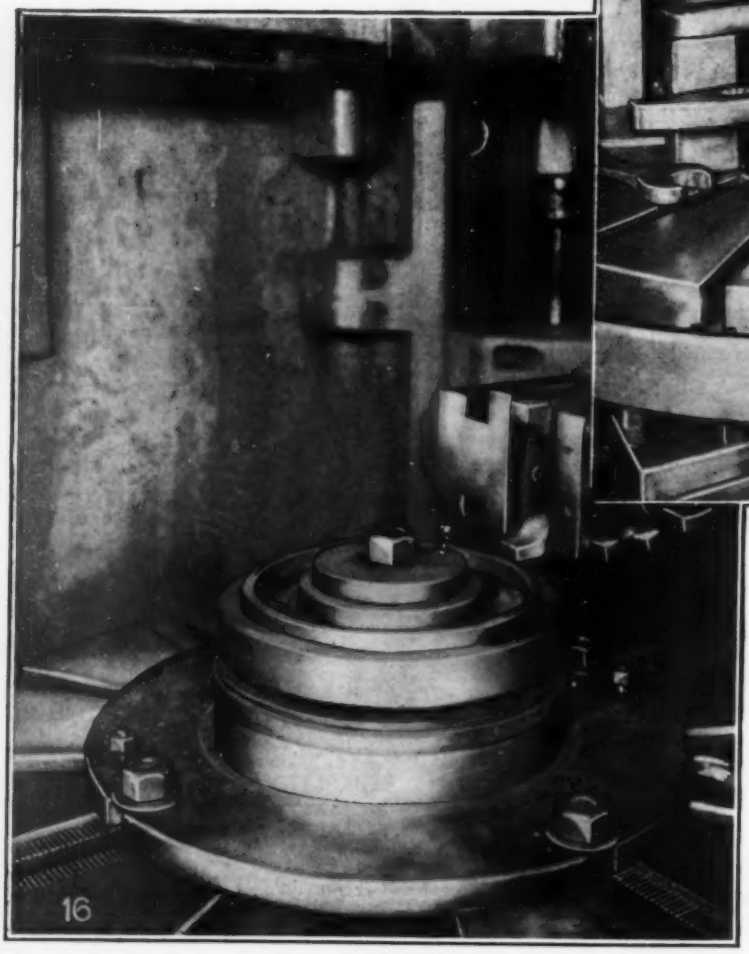


Fig. 16—Fixture for turning valve bull-rings on a Bullard vertical lathe. The rings are clamped by three fingers, or straps, that go inside the cored portion of the ring. Can be used for other rings also

Fig. 17—Turning and facing flange of cylinder head. The recess for the piston-rod end is being bored with the bar in the turret. The unusual shape of the head is to accommodate a piston of special shape

Fig. 18—Temporary connecting rod for use in setting valves on locomotives. These rods are adjustable as to length and to pin diameter, and can be used on a large variety of locomotives

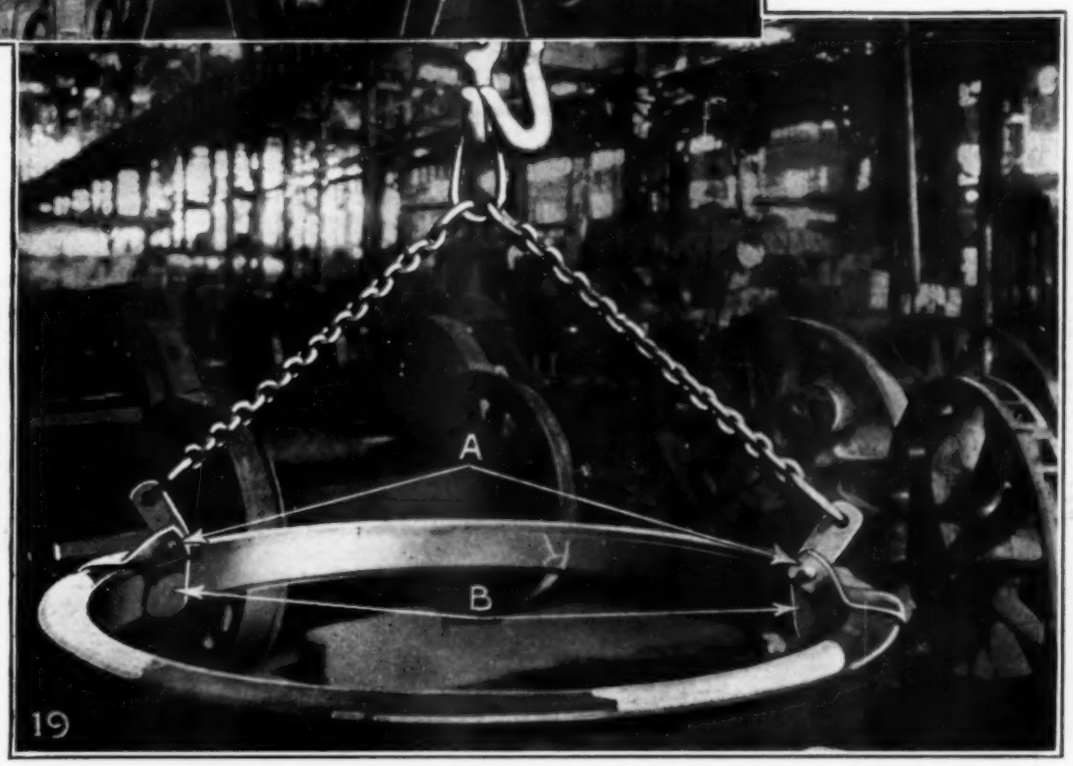
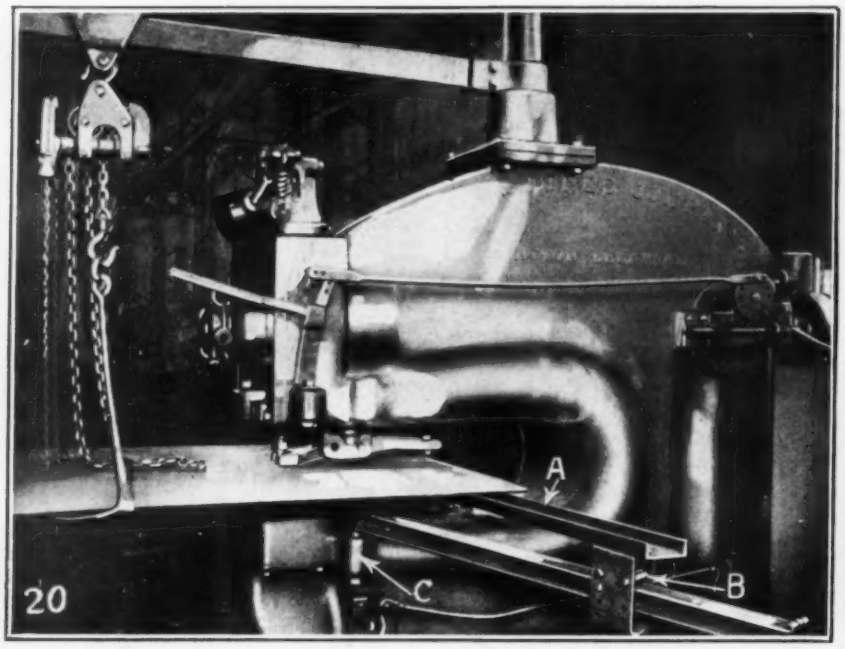


Fig. 19 — Clamps for lifting flanged tires. The swinging arm A hooks over the flange and is held from slipping by the action of the arm B on the inside of the tire. They are easily handled and hold the tire firmly



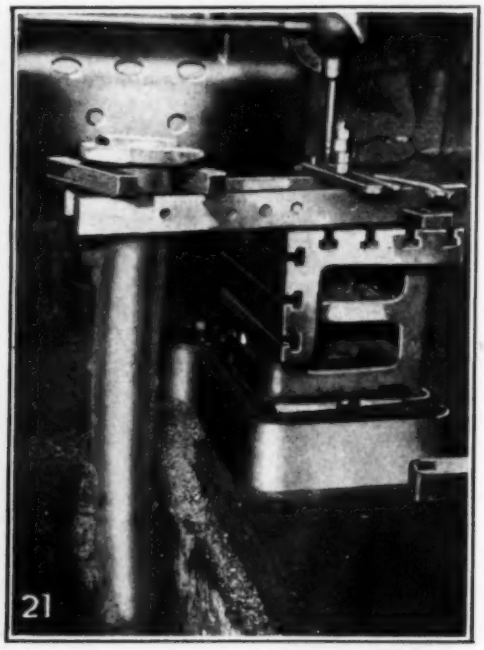


Fig. 20—Convenient support for guiding boiler plate into punch press. The sheet rests on the long channel iron that is supported on rollers at each end. These rollers are free to move on T-shaped supports at each side. Fig. 21—Pit beside radial drilling machine for handling steam pipes for drilling the flanges. The pit is covered when not in use. The pipe is supported by bars bolted to the table of drilling machine as shown

Another boring-mill job is the turning of a cylinder head as in Fig. 17. The combined use of the tools in the turret and in the side head enables two operations to be performed at the same time. The cylinder head is machined all over, the unusual shape being due to the type of piston used.

It sometimes happens that a locomotive may be ready to have the valves set before work on the main rods has been finished. To meet emergencies of this kind without delaying the work, temporary rods are provided, as in Fig. 18. These rods are adjustable as to length, so as to be used on locomotives of different classes. While but one such rod is shown, a number of them are available, although a single rod of this kind can be made to accommodate quite a variety of locomotives. The device has been found very helpful in preventing delays and in speeding the locomotives back into service.

Driving-wheel tires are always awkward things to handle, and a variety of clamps and slings have been devised for this work. The one shown in Fig. 19 is very simple but has proved effective on all sizes of tires. It is easily applied, since it is necessary only to hook the lip on the pieces *A* over the flange of the tire and then lift it. The pieces *B* bear against the inside and hold the clamps in place so that they cannot slip. A somewhat different clamp is used on blind tires, owing to the absence of the flange.

Fig. 22—Special bending block for bulldozer, used for bending sharp angles near the ends of fairly long pieces. The combination has been found very useful on a variety of work that is not easily handled without some such device

Another handling device, although for an entirely different purpose, is shown in Fig. 20. This device is for assisting both in holding and guiding large sheets in the throat of a heavy punch. The sheet is supported by a hoist on a jib crane and by hooks over the sides. The end of the sheet in the punch, however, rests on the channel-iron *A* having two rollers in a frame at each end, one of the rollers being shown at *B*. The rollers run on T-rails that swing from the sides of the press at *C*. The ends of the rails are turned up to prevent the roller support from running off. This arrangement makes it possible to move the sheet at will in almost any direction so as to bring it to any point under the punch.

Steam pipes are awkward pieces to handle on account of their shape and length. To provide for the drilling of the flanges, a trap door has been cut in the floor under a radial drilling machine, and the pipe is lowered into the hole for drilling, as in Fig. 21. The manner of supporting the pipe by bars extending over the pit, and by cross parallels, is clearly shown.

Bulldozer work includes a wide variety of shapes and sizes. In order to secure sharp bends such as are needed in some cases, the special block *A*, Fig. 22, has been made, together with the mating block *B*. Owing to the length of the block *A* from base to point, short bends can be made near the end of a bar, and is the reason for making this block so long. This combination has been found very useful in a large variety of cases.

The increasing use of machinery of all kinds, both in industry and in the home, assures a growing need for machine-building equipment for years to come.

Automotive Production

Glimpses of Mack Production

By S. J. KOSHKIN
Associate Professor of Machine Design, Cornell University

Machining transmission cases and differential housings

THE transmission case for the 3½-ton truck is an aluminum casting and it undergoes several milling, drilling and tapping operations.

Facing both sides of the case on a duplex miller, is shown in Fig. 12. But one of the two 18-in. inserted-tooth cutters is shown, the other one being hidden by the case. Milling the pad for the shifter housing is illustrated in Fig. 13. The work is done on a plain miller and is located from one of the surfaces milled in the previous operation. At the lower part of this illustration is shown the fixture for milling the power take-off pad.

Various holes are drilled in the three machines to be seen standing in line in Fig. 14. The machines are equipped with multi-spindle heads. The jig is of the trunnion type and is rolled from one machine to another for drilling different groups of holes. Boring and reaming the shaft holes is done in a horizontal boring mill, as shown in Fig. 15. The machine is equipped with driving heads carrying three reaming and boring bars.

Drilling, tapping and stud setting for the covers is done on an radial drill, as shown in Fig. 16. The case is held in an indexing jig and is located by two of the large holes bored in the previous operation. Housings for steering gears are drilled in a multiple-spindle drill, an indexing jig being used. Fig. 17 shows the jig with the lid open, while in Fig. 18 it has been indexed to another position. Completed housings can be seen in front.

In Fig. 19 can be seen the drilling of the retainer bearing for the main driving pin. The work is done on a multi-spindle drill. The jig is of the indexing type. Some of the holes drilled are through holes, while others are blind. The remaining three illustrations show some of the work being done on a differential housing. In Fig. 20 a duplex boring mill, with the heads set at an angle, is boring and line reaming three holes. In Fig. 21, is shown the jig for drilling one of the groups of holes in the housing. In the first part of the operation the holes are drilled half-way through. The jig is then indexed and the holes are completed by drilling from the opposite side. This method is used because in holes of this depth (3 in.) more accurate results are secured. The jig is then brought under the group of drills shown at the left in Fig. 22, and twelve holes are drilled in the flange.

The second article. The third will appear in an early issue.

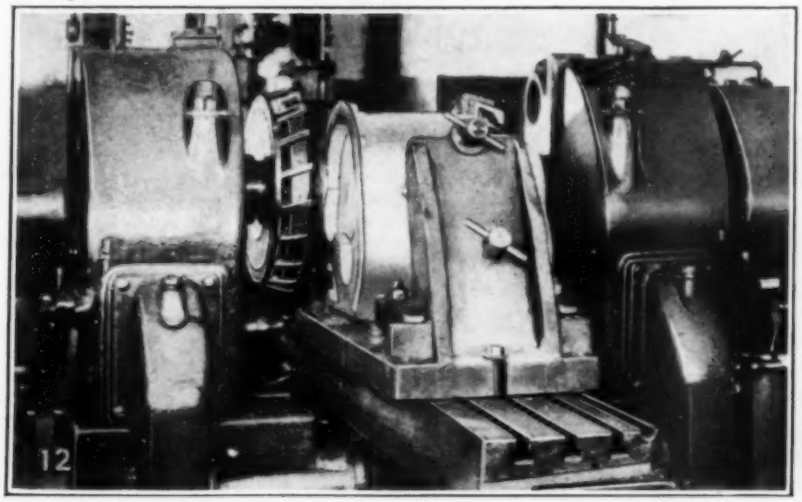


Fig. 12—Milling both sides of aluminum transmission case for a 3½-ton truck on a 48-in. duplex miller. Only one of the two 18-in., inserted-tooth cutters is shown. The other one is hidden by the work. Fig. 13—Milling shifter-housing pad with 18-in. inserted-tooth cutter on a plain miller. The pad for the power take-off is also milled on this machine, using an 8-in. inserted tooth cutter that faces the whole surface at one pass

Automotive Production

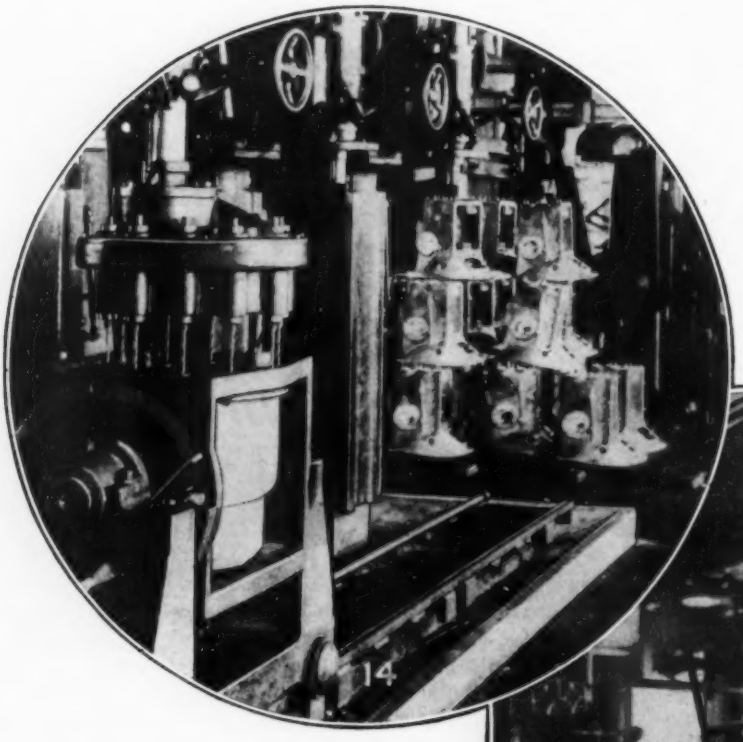


Fig. 14—Drilling and reaming holes on three faces of transmission case. The three drills stand in line and are equipped with multiple-spindle heads of which one only is shown here. The jig is of the trunnion type and is rolled from one machine to another

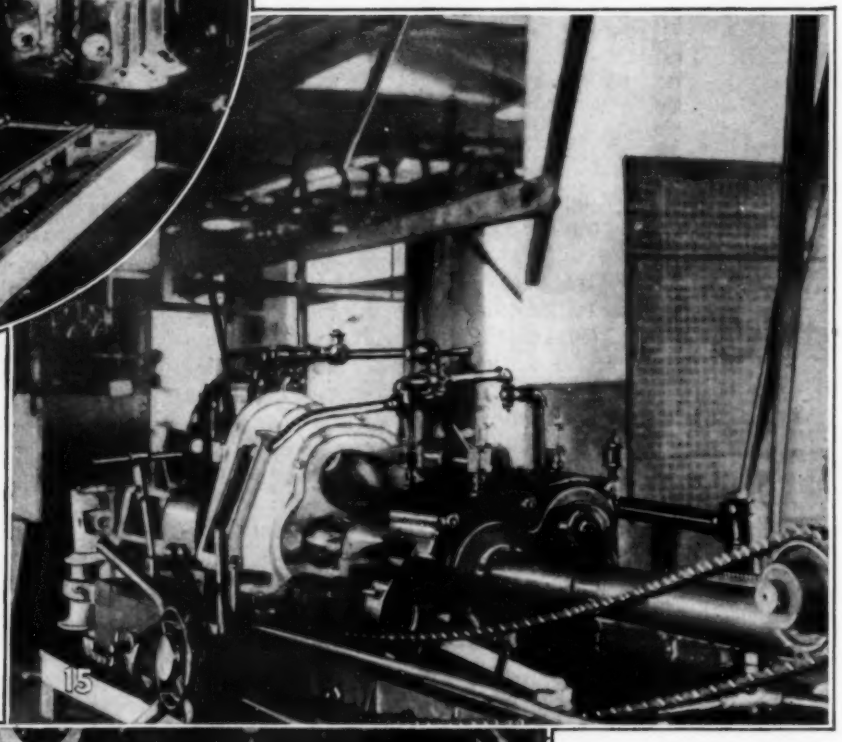


Fig. 15 — Boring and reaming operations on a horizontal boring mill. The machine is equipped with special driving heads carrying three boring and reaming bars. The bars are made to use special boring tools and reamers

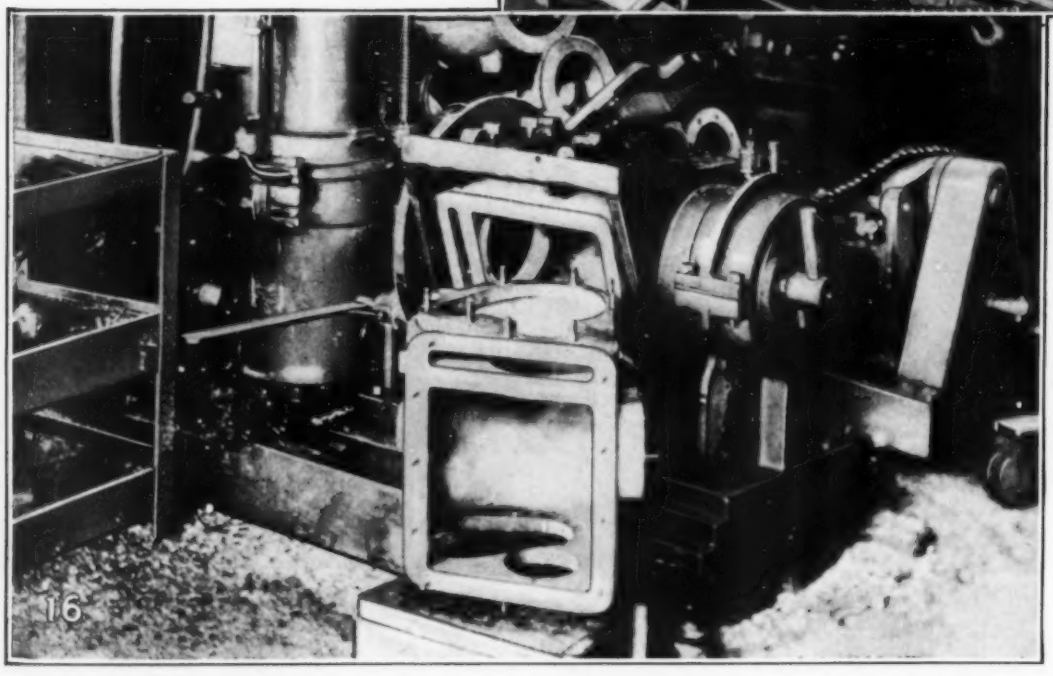


Fig. 16—Drilling and tapping holes, also driving studs. These operations are performed on a drill equipped with an indexing jig of the trunnion type. Tapping and stud driving is done on a radial drill with the case clamped to the table

Automotive Production

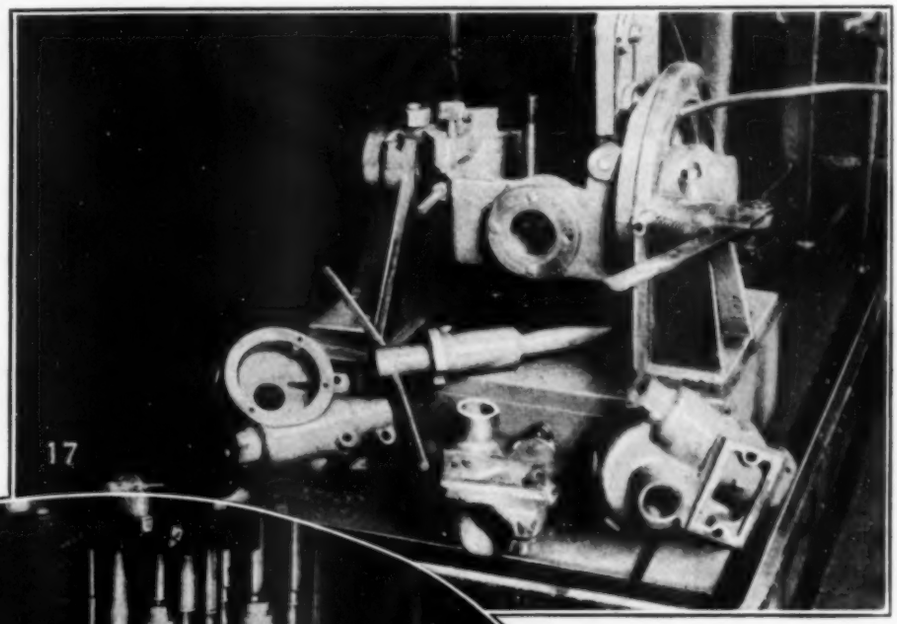


Fig. 17—Drilling operations performed in a trunnion jig on a steering-gear housing under a multiple-spindle drill press. The indexing jig is shown here with the lid open

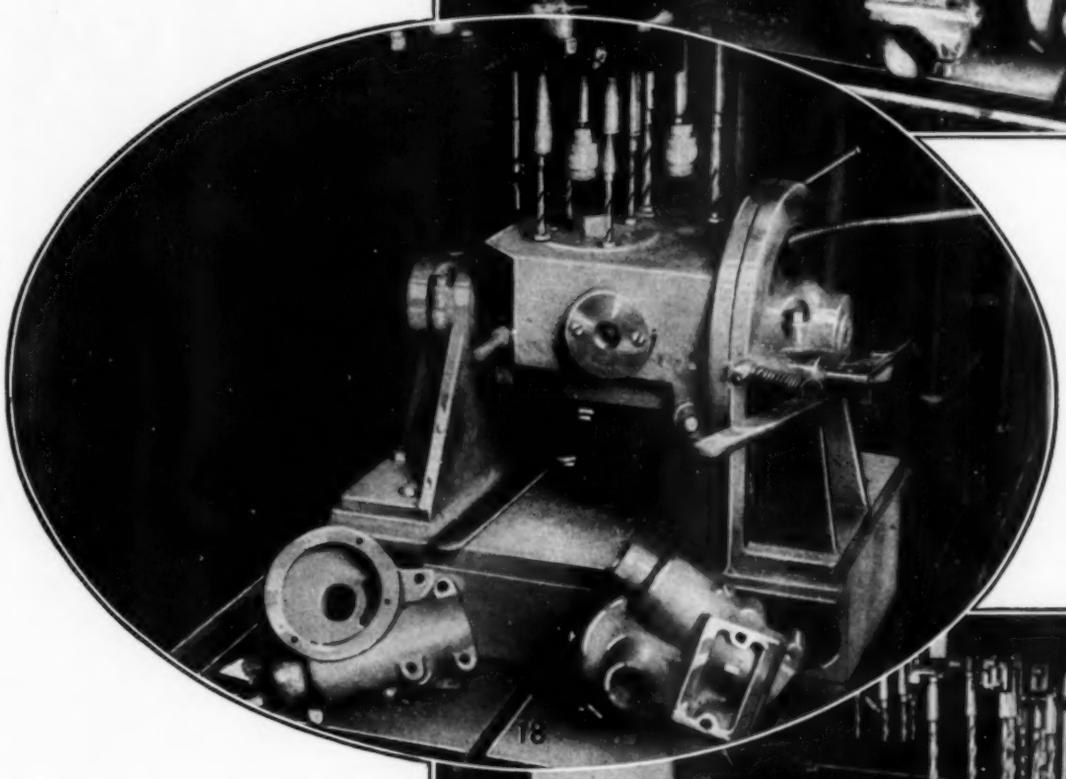


Fig. 18—The jig in Fig. 17 is shown here indexed for the operation of drilling four holes, and spot drilling two others. In the next operation, after indexing again, two combination drills and reamers are used in quick-change chucks

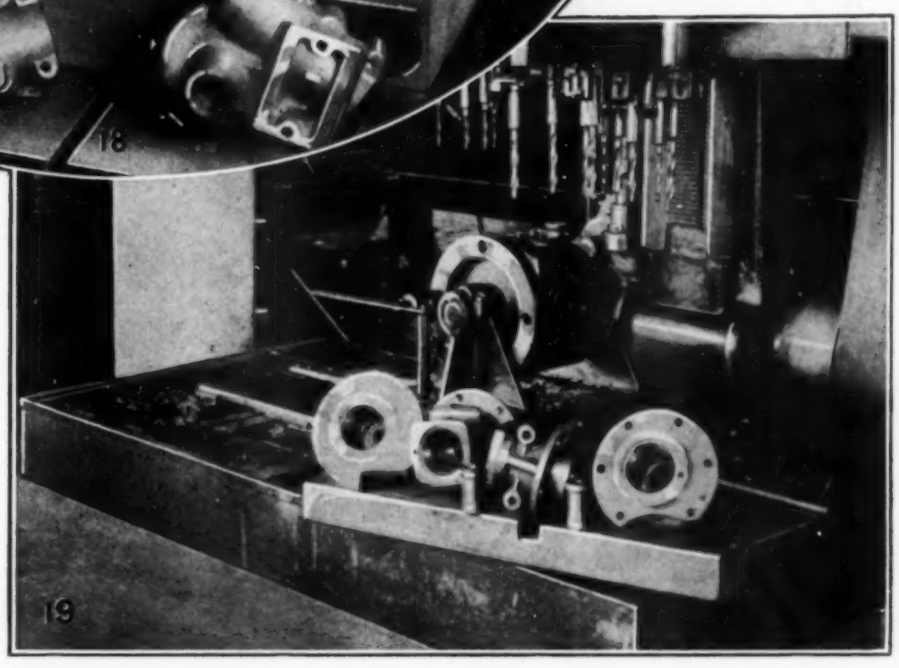


Fig. 19 — Complicated drilling operations required on the four faces of the retainer bearing for the main driving pin are easily performed with the trunnion drill jig, shown here on a multiple drill. Some of the holes are blind

Automotive Production

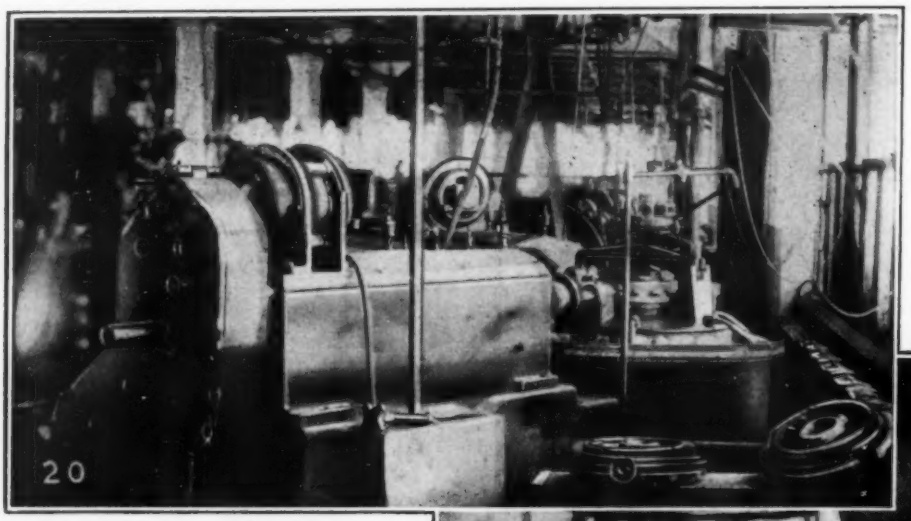


Fig. 20—Line boring and reaming three holes in a differential housing on a duplex boring mill in which the heads are set at an angle. A special adapter is used for this job

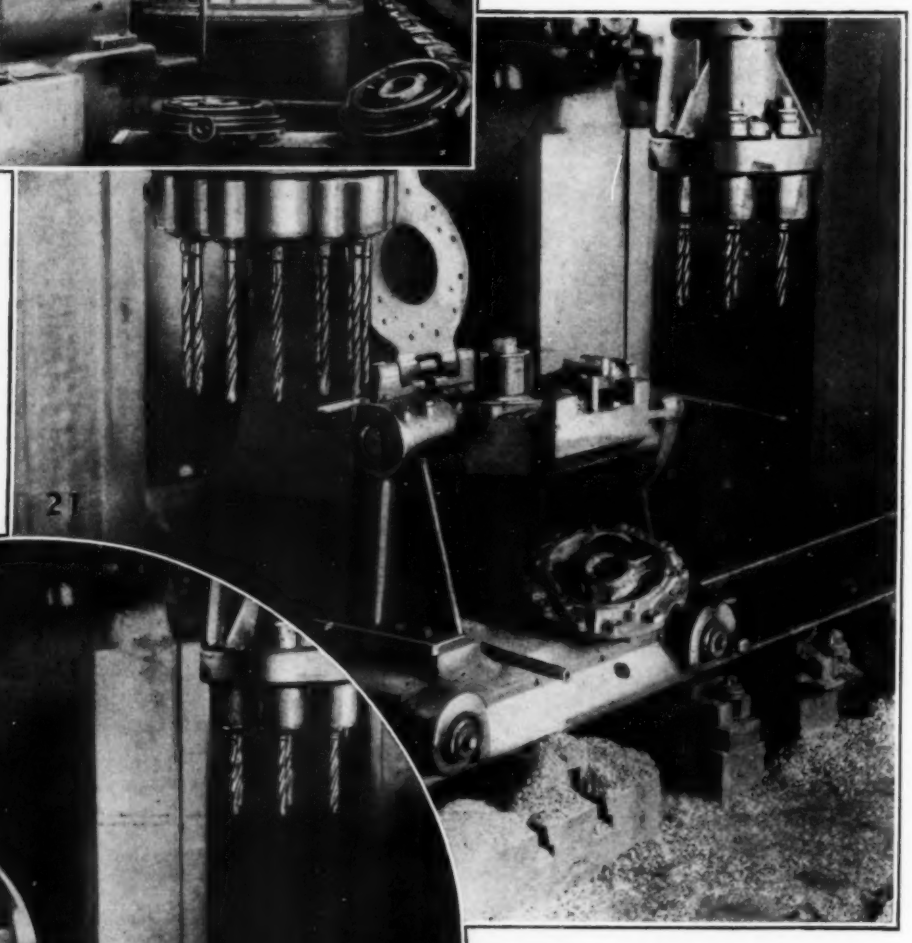


Fig. 21 — Drilling and reaming operations on differential housings are performed on heavy-duty drill presses by the use of trunnion jigs. One of the jigs is shown with the lid open

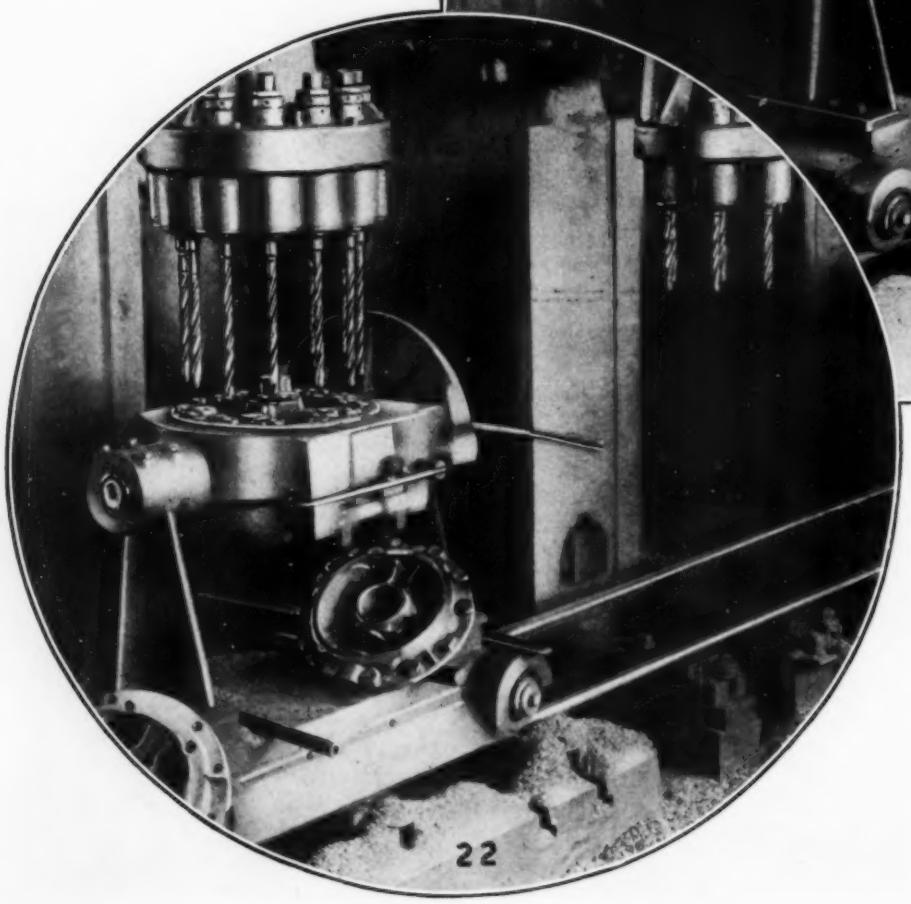


Fig. 22—After six long holes in the central part of the differential housing have been accurately drilled through and reamed (from both sides of the work) under one machine, the work is pushed under another drill press and twelve holes are drilled and reamed through the flange

New Theories in Tempering Steel

By Alfred Heller

Types of commercial tool steels, and volume changes due to hardening and drawing — Causes of warping and bulging — Variations in hardness due to tempering

AMERICAN water-hardening carbon tool steels as stocked by the various steel companies will generally vary between the following limits in analysis: Carbon 0.95 to 1.30 per cent, silicon 0.10 to 0.35, manganese 0.15 to 0.30. With the electric process becoming more and more popular, sulphur and phosphorus will as a rule be 0.02 per cent or under. The lowest hardening heat possible for steels of this analysis will be 1,375 deg. F. for a carbon content of 0.95 to 1.05 per cent, and 1,365 deg. F. for 1.05 to 1.10 per cent and over. Soaking for 15 minutes at the hardening heat will be necessary, and the steel must be "spherodize annealed." One manufacturer adds 0.12 per cent of chromium with 0.50 per cent silicon to his water-hardening tool steel, and in this case 1,420 deg. F. is the lowest hardening heat possible. Many manufacturers make a carbon tool steel with about 20 per cent of vanadium added. The lowest hardening heat for a steel of this type will be about 1,400 deg. F. If a piece of carbon tool steel is measured before and after hardening, it will be found to have increased in length, the increase being in direct proportion to the amount of carbon retained in solution. By referring to Fig. 4, it can be seen that the carbon expansion is directly proportional to the hardening temperature over the range investigated. Other tests showed that the expansion was completed when all of the carbon was absorbed. To be exact about this we would have to consider the shrinkage due to gamma iron retention, and therefore strictly speaking the expansion we measure is the expansion caused by carbon in solution diminished by the contraction caused by the retained gamma iron. Ordinarily, this expansion is called carbon expansion, the gamma iron contraction being ignored. From Fig. 4 it is apparent that for each 20-deg. increase in hardening temperature the linear expansion is increased 0.0004 in. In order to get these results, however, the test pieces must be hardened through without a soft core. High-carbon steel will not harden through at low hardening heats, and will show a contraction for this reason.

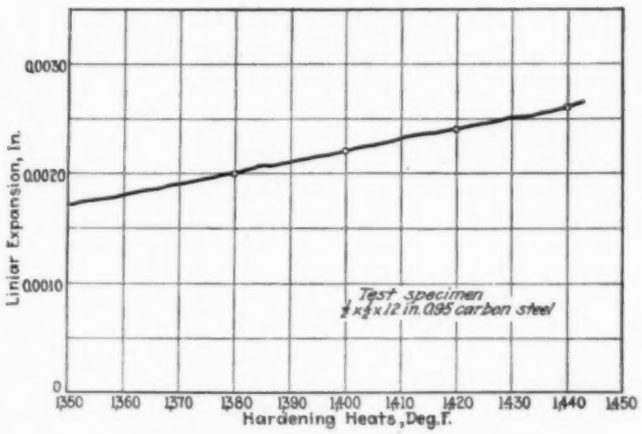


Fig. 4—Expansion in hardening tool steel

The upper curve in Fig. 5 shows the linear changes in hardening and tempering water-hardening carbon steel. The points plotted show the average length measurements of twelve samples of 0.95 per cent carbon tool steel, ¼x¼x1.9646 in., hardened at 1,375 deg. F. and 1,420 deg. F., respectively. The time of soaking at the hardening and tempering heats was 30 min. in all cases. From the curve representing the samples hardened at 1,420 deg. F., it is seen that the initial expansion of the twelve samples was 0.0048 in. in 2 in. Drawing to 212 deg. F. for 30 min. causes an average shrinkage of 0.0007 in., showing that a small amount of carbon has gone out of solution to form iron carbide. At 250 deg. F. a decided shrinkage has taken place, which is still further increased at 300 deg. F. From 300 to 350 deg. F. the shrinkage is only 0.00015 in., so that we can say that the bulk of the excess carbon retained in solution has been released at 300 deg. F. and completely released at 350 deg. F. Consequently, excess brittleness is very nearly relieved at 300 deg. F., and completely relieved at 350 deg. F. At 400 deg. F. an interesting physical change begins to take place. The steel begins to expand and continues to expand until 450 deg. F. is reached. As alpha iron occupies more space than gamma iron the only explanation is that the gamma iron is being converted to alpha iron with an increase in volume. Electrical and X-ray tests amply confirm this, so that we are sure that this expansion is caused by retained gamma iron breaking up into alpha iron. At this period there is a decided increase in toughness, taps, for example, made of carbon tool steel often break if drawn to 425 deg. F.,

The second article of the series. The final one will appear in an early issue.

but give excellent service if drawn to 450 deg. F., or better to 475 deg. F. After the gamma iron has been broken up into alpha iron the remaining carbon goes out of solution quite rapidly, the rate of precipitation being directly proportional to the temperature from 475 to 600 deg. F., as evidenced by the straight line of the expansion curve over this range. Moreover, there is a decided acceleration in the softening of the steel at this period.

All water-hardening steel "warps" or "bulges" in hardening and this phase of the hardening operation will be considered later. It will be seen from the curves in Fig. 5 that when drawn to 750 deg. F. the samples are actually shorter than before hardening. This contraction or shortening is caused by the warping or bulging effect in hardening, and each successive hardening will shorten the samples a little more. All steel expands in hardening, although at times with water-hardening steel the expansion is not always evident. Warping or bulging sometimes shortens a piece of water-hardening steel considerably, but the mass as a whole always expands in hardening. There is an exception to this rule in the case of alloy steels that contains such a quantity of alloying elements that when hardened at a high heat they retain a large amount of gamma iron. In this case the volume may be less after hardening if the contraction due to the retention of gamma iron more than offsets the carbon expansion. In general, however, steel always expands in hardening.

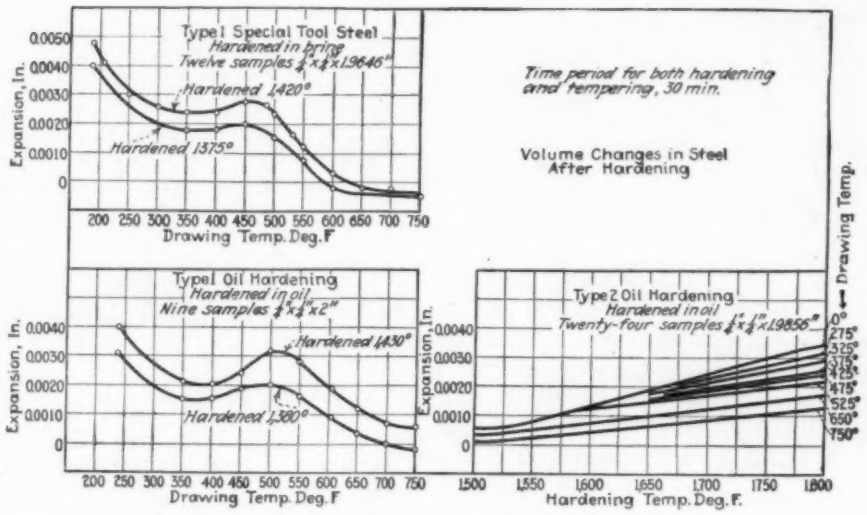


Fig. 5—Linear changes in hardening and drawing various steels

Referring to the curve in the lower right-hand corner of Fig. 6, measurements were taken of a bottom section and middle section before and after hardening and tempering. The change as a whole is a decided expansion, but measurements across the edge of a middle section show a shrinkage, caused by the warping effect. This bulging in turn is caused by the edges and corners cooling quicker, and therefore becoming harder during the quenching process than the middle of a face. Hence, when the expansion from gamma to alpha iron occurs, it follows the line of least resistance, and bulges out the middle of a face. It could be clearly seen that the small face which entered the brine first bulged or warped less than the face that entered the bath last, but as measurements were taken across faces this difference could not be determined. From an experiment in this line we determined that those parts of a test piece which cooled quickest changed least in hardening. These facts are often made use of in practical ways such as in drawing dies. When such dies are hardened, water is forced by means of a jig through the hole in the die, allowing the outside to air cool. This maintains the size of the hole very accurately. However, when the dies become worn they are "shrunk" by rolling them in water, causing the outside to cool first so that when the expansion occurs in the mass of the die it bulges in the direction of the hole, making this less in diameter.

The high-manganese type of non-deforming oil-hardening steel is popular among toolmakers and contains 0.85 to 1.00 per cent of carbon, 1.00 to 1.50 manganese, 0.15 to 0.35 silicon, and often small percentages of chromium, vanadium, or tungsten either singly or in combination. If this type of steel contains no chromium or vanadium it will harden to a Rockwell hardness of C65.5 at as low a temperature as 1,380 deg. F. If small percentages of chromium are present the hardening heat becomes 1,400 deg. F., and with 0.50 per cent of chromium 1,420 deg. F. must be used. If vanadium and chromium both are present the maximum hardness of C65.5 is only obtained with a hardening heat of 1,460 deg. F. Soaking for at least 15 min. at the above heats is necessary for proper hardening. A small percentage of tungsten has no appreciable effect on the hardening temperature.

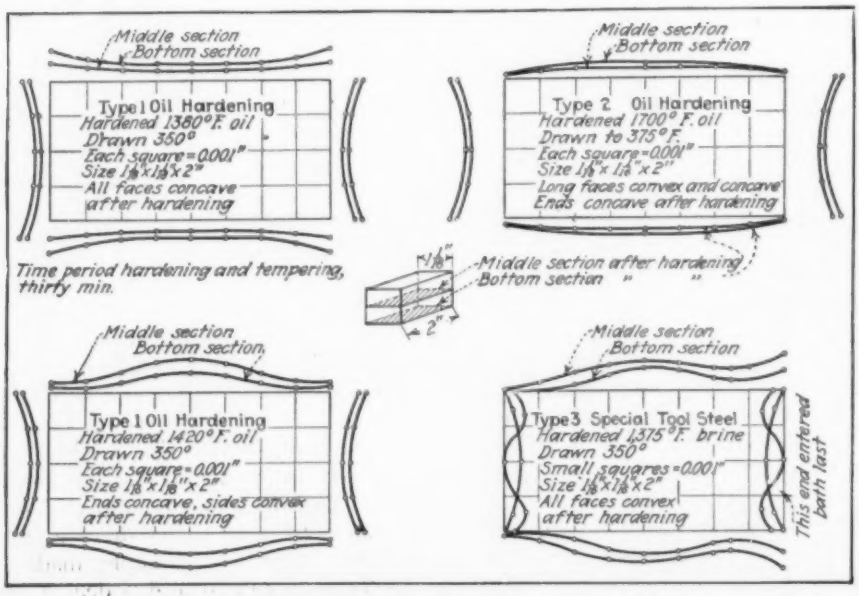


Fig. 6—Volume changes in hardening steels

The volume changes in tempering the high-manganese type of oil-hardening steel are shown by the curves on the lower left-hand corner of Fig. 5. These curves were prepared by measuring nine samples of high-manganese steel containing no chromium, vana-

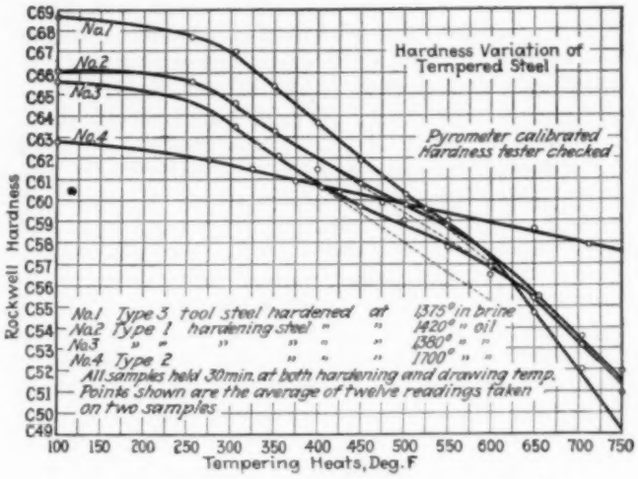

Hardness Variation of Tempered Steel
Pyrometer calibrated
Hardness tester checked
No.1
No.2
No.3
No.4
No.1 Type 3 tool steel hardened at 1375° in brine
No.2 Type 1 hardening steel " " 1420° " oil
No.3 " " " " " 1380° " "
No.4 Type 2 " " " 1700° " "
All samples held 30min. at both hardening and drawing temp.
Points shown are the average of twelve readings taken on two samples
Rockwell Hardness
Tempering Heats, Deg. F

Fig. 7—Variations in hardness in drawing steels

dium, or tungsten, both before and after hardening and tempering. As can be seen, the volume changes are greater when a hardening heat of 1,430 deg. F. is used than when 1,380 deg. F. is used. Referring to the curve of the samples hardened at 1,430 deg. F., it is seen that the steel in tempering shrinks rapidly to 350 deg. F., showing that the bulk of the excess carbon has gone out of solution at this temperature, which marks the point where practically all hardening strains are relieved. Beginning at 400 deg. F. an expansion takes place which assumes its maximum phase at 500 deg. F., which indicates that a large amount of gamma iron is retained in hardening this type of steel. The expansion is much less at 1,380 deg. F., and therefore a good rule to follow with this type of steel, and in fact with any steel where minimum "shrinkage" or distortion is desired, is to use the lowest hardening heat that gives the maximum hardness. We have yet to find a piece of any size of this analysis that will not harden properly at 1,380 deg., provided carbon deposits from the decompositions of the quenching oil do not cause soft spots. When chromium or vanadium, or both, are present, use the hardening heats previously mentioned.

The breaking up of retained gamma iron completes itself at 500 deg. F., or possibly 525 deg. F., and from this point on carbon goes out of the solution more rapidly, but not as fast as with carbon tool steel because of the obstructing effect to alpha grain growth of the high-manganese content in solid solution with the alpha iron. The two sets of curves at the left in Fig. 6 show volume changes in hardening pieces of high-manganese oil-hardening steel containing only a high percentage of manganese and no chromium, tungsten, or vanadium. The upper curve shows the volume changes when 1,300 deg. F. is used in hardening, and the lower curve when 1,420 deg. F. is used. The volume changes are entirely different; concave surfaces resulting with a hardening heat of 1,380 deg. F., and convex surfaces for the four sides at 1,420 deg. F., and concave surfaces for the ends. By cutting these pieces in two and determining the core hardness, it developed that the core hardness for the piece hardened at 1,380 deg. F., was the same as that of the samples hardened at 1,380 deg. F., and drawn to 650 deg. F., and therefore the core of the piece hardened at 1,380 deg. F., has the same volume before as after hardening and tempering. In a similar manner it was determined that the piece hardened at 1,420 deg. F. showed a core hardness corresponding to drawing temperature of 500 deg. F. where the steel reaches the peak of the curve for maximum expansion in tempering. This expansion of the core for the sample hardened at 1,420 deg. F., produces the convex sides. The ends cooling first, however, simply show the effects of the carbon expansion, and are therefore concave. In the case of the sample hardened at 1,380 deg. the expansion is only that caused by the carbon expansion, since the core has the same volume before as after hardening.

The high-chromium type of non-shrinking steel is becoming popular because of the great wear obtained through its use, and because shrinkage or warping can be held to close limits. The analysis is about as follows: Carbon 2.00 to 2.50 per cent, silicon 0.15 to 0.35, manganese 0.15 to 0.60, and chromium 12.00 to 15.00 per cent. Small percentages of vanadium, cobalt, or nickel are often used in addition. This steel has a wide hardening range, starting to harden at 1,500 to 1,550 deg. F., and then increasing with the hardening temperature until a maximum hardness of C68.0 is obtained at 1,800 deg. F. The best all-around hardening heat is 1,750 deg Fahrenheit.

Referring to Fig. 5, the curve in the lower right-hand corner shows the volume change for any combination of hardening and tempering covering a range of hardening from 1,500 to 1,800 deg. F. and a range of tempering up to 750 deg. F. From room temperature to 375 deg. F. there is a contraction, and marks the range over which excess carbon in solution is removed, and therefore marks the range over which hardening strains are removed. From 375 deg. F. to 475 deg. F. there is little change in volume. As there is no expansion at any period in tempering up to 750 deg. F., either this temperature is too low to break up retained gamma iron, or else little is retained in hardening.

High hardening heats cause water-hardening steel to be brittle because of the large amount of carbon retained in solution, and because of the presence of large quantities of gamma iron. Another cause for weakness when high hardening heats are used with high-carbon steel is due to the undissolved carbon segregating at gamma iron grain boundaries when a high enough heat is not used to completely dissolve the carbon. The network of

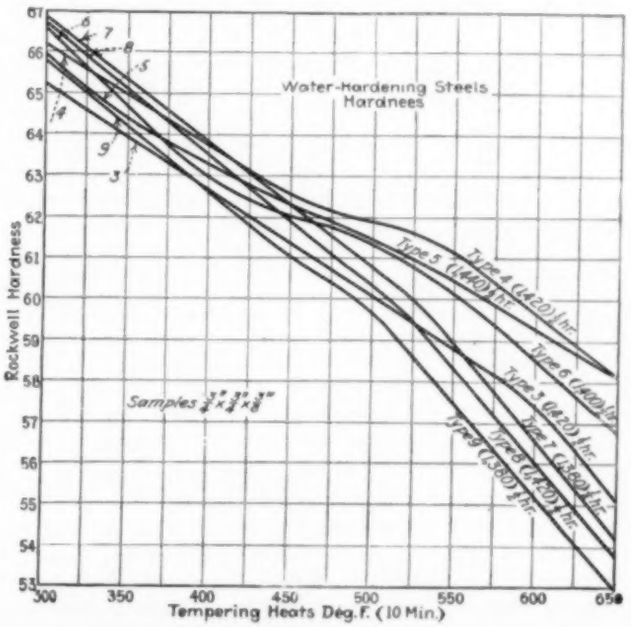


Fig. 8—Hardness changes in tempering tool steels

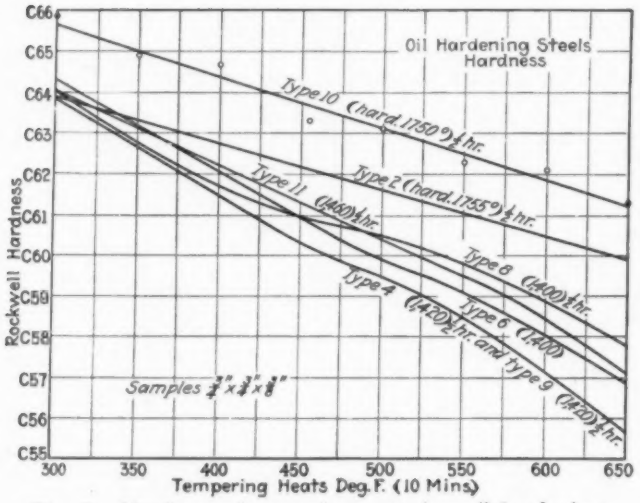

Oil Hardening Steels
Hardness
Type 10 (hard. 1750°) ½ hr.
Type 2 (hard. 1755°) ½ hr.
Type 11 (1480) ½ hr.
Type 8 (1400) ½ hr.
Type 4 (1420) ½ hr. and Type 9 (1420) ½ hr.
Type 6 (1500)
Samples ¾" x ¾" x ⅜"
Rockwell Hardness
Tempering Heats Deg. F. (10 Mins.)

Fig. 9—Hardness changes in tempering oil-hardening tool steels

carbide produced is a source of brittleness in the steel. A similar condition is produced by improper forging, rolling, or annealing. The micro-photograph shown at Fig. 2 shows carbon precipitated and distinctly outlining the former grain boundaries of the gamma iron grains. In the case shown at Fig. 3 the iron carbide was crushed into fine particles and retained as such by finishing the rolling at about 1,300 deg. F. Annealing was then done at a temperature about 1,300 deg. F. Such a distribution of the carbon is almost ideal for ease of machining, susceptibility and uniformity in hardening, and maximum wear and strength after hardening. A steel with this structure will always harden to a Rockwell hardness of C68.0 by soaking for 15 min. at 1,365 deg. F. and quenching in brine, provided that the carbon is 1.10 or over. With the carbon content 0.95 to 1.10 a hardening heat of 1,375 deg. F. must be used.

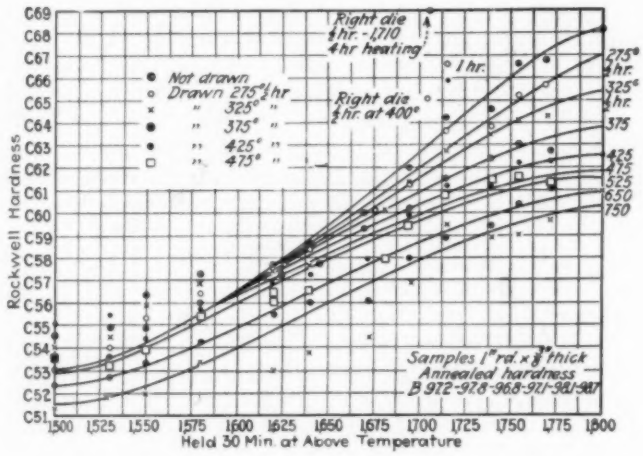
There is nothing accurate about the file test for hardness testing, although this method is still largely used. Testing for decarburization (soft skin) is best done with the file, but it is impossible to determine the degree of hardness accurately except by the use of a standard hardness tester. The Rockwell tester was used in all of these experiments because it is adapted for testing very hard steel of almost any size.

The curve in Fig. 7 represents the variations in hardness in drawing a 0.95 carbon tool steel, hardened at 1,375 deg. F., from 100 to 750 deg. F. Softening of this steel only begins at 300 deg. F. From 300 to 400 deg. F. the softening is directly proportional to the growth of the alpha crystals with their mixture of gamma iron. Between 400 and 500 deg. F. a slight retardation in the rate of softening is evident, and is caused by the retained austenite converting to alpha iron. The alpha iron crystals are harder than the gamma iron, which is the cause of this retardation. However, after the gamma iron has broken up there is a decided increase in the rate of softening of carbon tool steel, and the softening from 500 to 750 deg. F. is directly proportional to the increase in temperature.

In Fig. 8 is shown a group of curves giving the variations of hardness in tempering some of the most widely used water-hardening carbon tool steels on the market. One of these is a foreign steel, and the rest are American steels. It is interesting to note how a small percentage of chromium with high silicon causes a decided retardation in the tempering effect at the higher temperatures. For those who are not familiar with hardness readings, Rockwell C63 to C64 is the maximum hardness that can ordinarily be touched with a file.

High-manganese non-shrinking oil-hardening steel, because of the large amount of gamma iron retained in hardening, can always be "touched" with a file even when Rockwell readings as high as C66.0 are obtained, the exception being when cyanide is used in hardening. Curves 2 and 3, Fig. 7, are of the high-manganese type without any other alloys, and show that this steel softens in direct proportion to the increase in temperature up to 400 deg. F., when the gamma iron begins to break up. From 400 to 500 deg. F. there is a very marked retardation in the tempering effect, but after the gamma iron has completely broken up the softening is accelerated. But this rate is always slower than the rate of the tempering effect of water-hardening carbon tool steel because of the high manganese content.

In Fig. 9 is shown a set of curves of the most popular oil-hardening steels on the market. Compare the



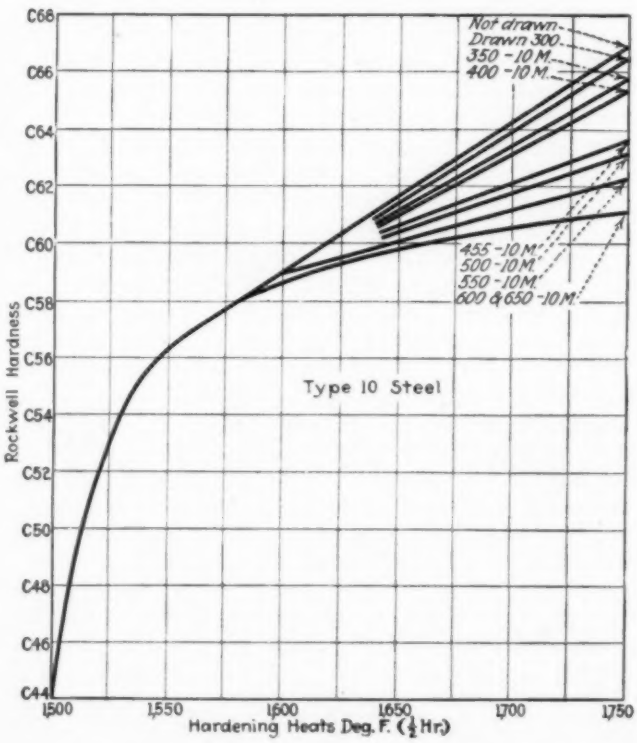


Fig. 10-11—Curves showing tempering effects on high-chromium oil-hardening steels

analysis of these steels with their tempering curves and note how chromium, tungsten, and vanadium retard the tempering.

Curves showing the tempering effect of high-chromium oil-hardening steel, together with the hardening temperature used, are shown in Figs. 10 and 11. This steel is remarkable because of the wide hardening range possible. Hardening begins at temperatures as low as 1,425 deg. F. From this temperature up to 1,500 deg. F., or 1,550 deg. F. in the case of the type containing cobalt, the hardness increases very rapidly. From 1,500 deg. F. up to 1,800 deg. F. the hardness steadily and uniformly increases until at 1,800 deg. F. a Rockwell hardness of C68.0 is obtained. At the low hardening heats practically no volume change occurs. The tempering effect up to 750 deg. F. is directly proportional to the temperature.

From the foregoing it can be seen that there are critical ranges in tempering. The first of these is where the excess carbon goes out of solution, and occurs at about 300 deg. F. with water-hardening steel, 325 to 350 deg. F. with the high-manganese type of oil-hardening steel, and at 375 deg. F. with the high-chromium type of oil-hardening steel. Over this range most of the excess hardening strains are relieved. The second critical range is where the retained austenite (gamma iron) breaks up, with a marked increase in toughness, and occurs at 450 to 475 deg. F. with water-hardening steel, and 500 to 525 deg. F. with the high-manganese type of oil-hardening steel. There is no evidence of such a point for tempering heats up to 750 deg. F. with the high-chromium type of oil-hardening steel. Around these points small variations in temperature cause marked changes in the toughness of the steel with little change in hardness. These ranges, or points, in tempering should not be confused in any way with the critical point in hardening steel, which is the temperature where alpha iron converts to gamma iron.

Old Man Johnson Loses Out on Machines on Trial

By John R. Godfrey

OLD man Johnson met his "come uppance" the other day—as we used to say back in New England. A nice young chap who was selling machinery tried to interest him in a new grinding machine, assuring him that it would earn him a nice profit on his valve-guide job.

"Looks like a good machine, young man," said Johnson, "but how am I going to know what it will do?"

"Send us a bunch of your valve guides and we'll grind them for you, give you the grade of wheel, speed, feed, and time. If it can't do the job at a good profit to you on the cost of the machine, the loss is ours."

"Why not put a machine in the shop for a month and let us see what it will do?" said the old man.

"I'll tell you why, Mr. Johnson. We know what it will do and we'll prove it to you on your own work. But we want to prove it to you at as little expense to us as possible. You're the one who has to be educated and who will make the most money out of the deal. We make one profit—and it's none too large—while you'll be getting a profit every day you run the machine."

The Old Man was a bit dumfounded. Most builders of machines jump at the chance to put a machine in on trial. He actually thought he was doing the young man a favor. And he said so with his accustomed vigor. But the young man wasn't a bit abashed.

Who Pays for Education

"That's a good theory, Mr. Johnson. And it may be all right when someone is trying to spring a new and untried machine on the unsuspecting public. But that isn't our case at all. Others are using our machines to do similar work, and saving money. Just why should we pay for educating your shop manager when it's his job to keep posted?

"I know many builders of machines would jump at the chance. We just naturally shy the other way. It costs us a lot of real money to put a machine in your shop, and demonstrate it for a month. When we get through, if you decide not to buy it, for any reason whatever, we've got a used machine on our hands. No matter how good the machine may be, we lose if you say it doesn't do the work. And you know how the best machine in the world can get a black eye if the foreman or operator happens to be grouchy about it."

"Well, that's a new slant on it at least, young man." Johnson always did try to play fair.

"Tell you what we'll do, Mr. Johnson. We'll put in a machine for a month on these conditions. You pay the cost of shipping the machine the same as you would if you bought one direct from us. You pay us for the use of the machine during the month at the same rate as the machine cost was on your old machine. That will pay us for the use of the machine and the operator. If the machine doesn't make good after a fair trial, we'll pay the return charges. But it won't come back, Mr. Johnson.

"Or, if you prefer, send us one of your operators and we'll train him in our shop, you paying his wages and expenses. Then we'll only charge you the machine cost per piece at the same rate you are paying with your present machine."

"None of the other builders talk that way, son. Don't see just how you get away with it."

"Well, let's look at it this way, Mr. Johnson. Suppose six builders each sends you a machine for a month's trial. Each builder pays heavily for freight, operator, and wear and tear. Five of the builders must lose, and the loss will be a lot more than the profit the winner gets.

"You, on the other hand, win on every count. You get six months' use of machinery free. You get a free education as to the different machines. You profit from six machines while the builders of five of them, at least, lose.

"Furthermore, Mr. Johnson, you continue to get profits from the use of the machine you keep, until a better machine is developed. You can't lose—and five of the builders can't do anything but—"

And Johnson is wondering just how near right the young man was, after all.

To find out whether or not you are thinking clearly, try writing your thoughts on paper, with the object of making them easily understandable by other people.

THE · FOREMAN'S · ROUND · TABLE

Side-Tracking an Old Customer

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

THERE was a conference on in Williams' office. An order for a new customer was a bit behind schedule, and he wanted to see what could be done about it.

"Can't we side-track that job of Brown's, Mr. Williams? He's an old customer, you know. We've been doing his work for years. He won't complain. Probably he'll never find it out anyway," said Ed.

"What do you think about that, Al?"

"If you really want to know, Mr. Williams, I think it is darn poor business. Brown may be good natured, but if he finds out that we've side-tracked his work to give some new customer early delivery—well, I don't want to have to explain it to him—that's all."

"But what can we do, Al? If we fall down on the first order of this new firm, we've lost a customer sure."

"Maybe so, Ed. But I'd rather lose a new customer than an old one. We know Brown's work, he's good pay, and we don't know much about the new customer yet. He may be better, but we don't know it—and we're taking a chance if we neglect Brown until we find out."

"I never worked in a shop yet where they didn't do it, Al. Seems to be pretty general practice."

"Guess you're right there, Ed, but that doesn't make it right, or the best way to do. I've known several cases where the old customer did find it out, and there was *some* row. And the worst of it is we all knew he was right."

"Well, what's your answer then, Al?"

"I'd ask either Brown, or the new man, for an extension of time—or I'd put in overtime to catch up. I don't like overtime, and I know it's costly. But it's cheaper than falling down on the promised delivery date for the new customer, or getting in Brown's bad graces."

Was Al right in sticking up for Brown's work? Was Ed correct as to it being general practice to side-track an old customer? What is Williams' decision to be?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Posting Too Many Rules

IF THE man is a desirable employee, handing out a book of rules for every possible breach will make him feel that the management underestimates his ability to conduct himself in a proper manner, and will also make him feel that he will make his job do until something better turns up where men are treated as responsible workmen rather than like inmates of an institution. Of course, such rules as time-clock routine, safety, and drawing out of tools, which are peculiar to each shop, should be in printed form, or posted in a conspicuous place. I have watched many men in many shops and have invariably found that the new man will pattern his ways and habits after those of the other employees, and after condition of the shop in general. If the shop and equipment is dirty, and the men are allowed to be careless, squirting tobacco juice all over the floor, it is a ten-to-one shot that the new man will gradually fall into the same habits. Or if his nature is such that he takes exception to such conditions, he will soon quit. If, however, the shop and equipment are clean, and as tidy as possible, and the men careful and orderly in their habits, the new man will be quick to observe this and follow along in their footsteps. The shop department and environment are largely the responsibility of the foreman, and this can be built up far better by good example and word of mouth than by a long list of printed rules. If he is a capable executive and has the ability to make his wishes known in the correct manner, the men will not be slow to fall in line with his requirements.

—C. L. ANDERSON, *Methods Engineer.*

THE · NEXT · TOPIC

Calling Down the "Old Man's" Relatives

ADVANCE QUESTIONS

Should there be any exceptions to rules posted in the shop? Should officers or visitors be allowed to break them? Can a watchman be blamed for trying to enforce the rules?

Chrismas Parties in the Plant

A REAL get-together party held at the Christmas season has many points to its advantage, and consequently because of the benefits derived from such an affair by both the employee and the employer, the firm should regard such a venture with great favor and do all in its power to help put the party across. One of the benefits to be gained is that it brings together all men directly concerned in the welfare of the shop to a friendly gathering where all mingle freely with each other regardless of their status in the every-day production class. This tends to dispel any ill feeling that may have resulted during the year due to minor difficulties.

Such parties will also bring the workmen to a clearer realization that the firm is interested in their welfare, and the thought that they are considered as human production machines will entirely vanish from their minds, and give them full confidence in their superiors. This point is the one in which the employer is most interested in, for a satisfied production force is a vital necessity. Although numerous other reasons could be favorably commented upon regarding Christmas parties in the shop, the ones given stand out clearly and firmly as the basis for such affairs.

—PETER HAGEN.

Foremen As Inspectors

IN ORDER to avoid waste in manufacture, replacements on account of defective parts, or faulty operation after the product has been sold some form of inspection of the article during its manufacture is necessary. Such inspection may devolve upon the workman, the foreman, or upon an inspector appointed for the purpose; or each of these individuals may have inspection duties, depending upon the type of product manufactured, the method of manufacture, or the quantity. In the small factory where only a few machines are being built, and where interchangeability is not of consequence, the foreman may inspect the work, or he may delegate this duty to workmen who are experienced enough to carry it out successfully. With mass production of interchangeable parts, made on automatic machines requiring speed on the part of the operator, the machine inspector is almost a necessity; not alone to insure accuracy of the parts being made, but to relieve the operators and the foreman from interruption of their duties. Regular inspection of the product at intervals, as it comes from the machines, by a man familiar with the use of gages, insures that tools are at all times accurately set and sharpened without constant attention of the operator, who then can concentrate on production. Where accurate gaging is required, as in cases where the tolerances are small, considerable experience is necessary in handling the gages and unskilled machine operators may not be competent to undertake the work. Disputes between foremen and inspectors are liable to occur in regard to whether a doubtful part should be accepted. In such case it is customary to abide by the decision of the inspector, or to refer the question to a higher authority for a decision.

—S. C. MARTIN.

Receiving Personal Mail in the Shop

THE receipt of personal mail is considered in our shop as rather unavoidable, but it has been greatly reduced by the following practice: A small colored paster, on which the following words are typed, is pasted by the office on any piece of personal mail received, "Kindly ask your correspondents to address your mail

home, rather than to the shop. It is safer, as your letters may be opened inadvertently. And it will save us some time. With thanks. The Manager." The mail thus prepared is sent to the man, addressed through his foreman, who will, in case of abuse, point out the inconvenience of the practice. —Robert A. Caussin, *Belgium.*

JUDSON, in objecting to the men having mail addressed to the shop, evidently holds the view that the men are merely to be regarded as machines. This is excusable, perhaps, in an office manager, who works mainly with figures. But the foreman has men to deal with, and is their leader. Leadership demands sympathy and understanding, and to deny a man the privilege of receiving mail addressed to him, or to delay its delivery, is not sympathy.

The cost of delivering the small amount of mail received by the men is actually almost nothing. And for these grains of consideration, a harvest of good will is returned. Moreover, it increases the man's self-respect to know that he is a sufficiently important unit of the firm to have mail delivered to him.

—F. C. Edwards, *England.*

SURELY, it is elementary courtesy to deliver letters to a shopman with the utmost dispatch. Evidently, Judson does not realize that he is robbing the workman of the contents by delay. Of course, it is another thing to receive a regular mail. A firm cannot be expected to act as a sub post office. But there is really no fear of that, for the average man does not expect nor care for his correspondence to be addressed to the shop.

—J. E. Johnson, *Inspector.*

What Is the Foreman's Job?

IT HAS been my lot to be in a general shop where I have had to be responsible for the general layout and run of the shop, give out the work, design tools, and teach the men how to do the work. Generally, a foreman's job does not end with just getting out the work, as stated by Ed. The foreman often has to be consulted by the various heads of departments, including the general manager, on all sorts of questions from design to shipping, and these are the jobs where real foremanship shows.

—H. Maplethorpe, *England.*

Insurance and Savings in the Shop

THE workman whose economic life partakes of the feast and famine variety is to be pitied. The majority of welfare bureaus and aid societies would close if those who work for a living would be compelled to save something out of each pay day. When adversity strikes the ordinary worker, who hasn't put aside something for the rainy day, the man's family is naturally the first to suffer. So I am in favor of any plan in the shop that would encourage thrift and preparedness to meet the unexpected. —Samuel Kauffman.

Learning the Value of Deferred Judgment

I KNOW of a case where a batch of twelve tapered shafts was being machined, and as this particular shop was not large enough to merit an inspection department, the foreman checked all finished work. Inspecting this job, he found the taper was $\frac{3}{32}$ in. out, according to his gage, resulting in the job being scrapped and the man dismissed. A few days later, on reviewing the job, he found that he had been using the wrong gage. It stands to the foreman's credit that he instantly sent for the man and apologized for his blunder. But if the policy of deferred judgment had been followed, and the case had been investigated by a third person, this unpleasant situation would not have arisen.

—R. G. Hewitt, *England.*

Getting Ideas From New Men

I GET a lot of ideas from my men, and a lot of grief along with them. As a general thing, the worth-while suggestions come from the older men. And I don't mean that all of the suggestions submitted by the older men are worth while either. Right there is the trouble. A lot of my time is taken up sifting the wheat from the chaff. And Pete doesn't like it a bit when his idea is returned as impractical, while Bill's idea is adopted. However, I figure that is part of the price we pay for progress.

—L. B. Jones, *Shop Foreman.*

Making Time Studies

AS TIME studies are a co-operative effort, they should, consequently, be made in the open. The foreman, although not having direct control over the time-study man, is responsible for the morale and output of his department, and, therefore, he should be able to register directly an objection if the activity of the time-study man interferes with the work of his men. In fact, he has even more right to expect the time-study man to work with him than the men have, and this right must be respected. —George Neill.

THE foreman is vitally interested in accurate time studies, since his production is directly dependent thereon, and aside from any question of rate of pay, he must know how long any given job will take to complete. Therefore, the closest co-operation should exist between foremen and time-study men. The following check of all time studies is advisable, and can generally be depended upon as accurate: 1. The average man's hourly production on any given item for a period of time, as shown by work cards. 2. The maximum hourly production of a competent and trustworthy workman. 3. The average hour production of a number of picked operators for a given number of hours each.

—L. B. Jones, *Shop Foreman.*

A WELL organized time-study division could not work under cover, as there is much more than the actual observation involved, and it is necessary to get the confidence of the employees in order to make time-study observations of any value. Most workmen will co-operate when they are satisfied that it is not the policy of the company to "cut to the bone," and with a time study that is made with equal fairness for both sides, the workman and the company will prosper.

In some instances, I have known the workman to make the request of the foreman to get a time-study man on the job and set a piece rate for him to work by.

—Thomas H. Jones.

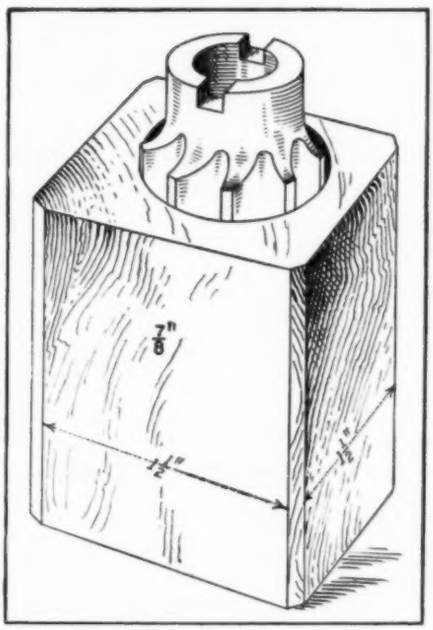
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of infomation on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit

Protecting Shell Reamers from Damage

By H. L. Wheeler

It pays to take good care of shell reamers, keeping them sharp and protecting them from damage, such as frequently results from careless handling and storage. One shop employs the simple but effective method shown in the illustration. The device consists of a hardwood block cut to suitable dimensions and bored about $\frac{1}{32}$ in. larger than the reamer size. For reamers from $\frac{1}{4}$ to $\frac{1}{2}$ in. in diameter, the outside dimensions of the blocks should be about $\frac{3}{4}$ to 1 in. square; from $\frac{1}{2}$ to 1 in., the outside should be about $1\frac{1}{2}$ in. square. As the reamers increase in size, the outside dimensions of the blocks should increase proportionately. All of the blocks should be the same height. The size of the reamer is stamped with large figures on the outside of each block and the figures are inked in so that they may be quickly read from a distance. In use, the reamers are issued from the crib in the blocks.



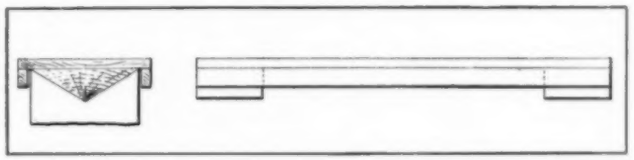
Protecting block for a shell reamer

Protection for Planer Ways—*Discussion*

By D. C. Wright

After reading the article by H. L. Wheeler, under the title given above, published on page 442, Vol. 67 of the *American Machinist*, I wish to suggest what I think is an improvement in the device described by Mr. Wheeler.

The improvement consists in providing the covers with drop flanges at the sides, as shown in the sketch. While covering the tops of the ways only will do a lot toward protecting them, there is always a tendency on the part of floating dust and grit to sift into the cracks between the covers and the tops of the ways and to settle in the Vs. Our experience with ways protected on the tops only, has been that in a very short time a "feather" of impounded grease and dirt had formed in the ways, the deposit of dirt being thicker at the outside and diminishing toward the center.



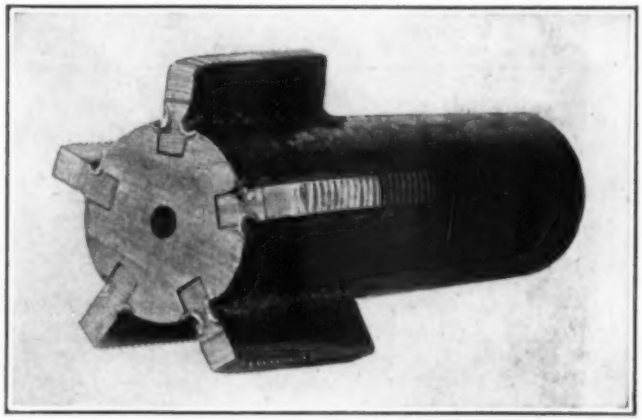
Improved protectors for planer ways

The addition of the drop flanges effectively covered the cracks between the protectors and the ways, and made it necessary for the dust to travel upward and then turn a corner before it could settle in the Vs. With the drop flanges added to the protectors, very little dirt was found in the ways.

An Emergency Tap

By M. W. Elmendorf

We were confronted with the problem of tapping a $3\frac{1}{2}$-in. pipe thread in an assembled part too large to chuck in a lathe. The threads had been roughed out but not finished before assembly. The error was not discovered until final inspection, the day before shipment. To avoid the customer's cancellation on account of failure to ship on contract date, it was absolutely necessary to procure a tap in one day. Telephone communications soon proved that $3\frac{1}{2}$-in. pipe tap was a rare article with supply houses, and ten days to two weeks delivery seemed to be the best offer. A phone canvas of job shops failed to bring results, so I made the tap shown in the illustration, in the following manner:



Tap built up by welding

An end from a piece of 2½-in. cold-rolled shafting was cut about 8 in. in length. One end was slotted on the milling machine at five equal points around the shaft. Into these slots were electrically welded five tool-steel blades ⅜ in. thick. The shank was then centered and a standard pipe thread was cut in the blades. The threads were relieved slightly by hand filing. Next the entire tool was heated to a good cherry red and then quenched, the shank being left red hot for drawing the temper. One cutter was quickly polished and the temper was drawn to a light brown. Drawing took place evenly as all blades were of the same size and the same distance from the heated shank. A ¾-in. hole was drilled through the upper end of the shank to insert a bar for turning the tap.

The tap performed perfectly in steam bronze, and saved the cancellation of a special piece of equipment. It was made in 3¾ hr. from available material, costing less than a standard tap, and is still being used for finish tapping. This idea can be used not only for odd-sized taps, but for reamers and milling cutters. The welding may not suit a toolmaker's eye, but it does the trick and furnishes a practical tool readily and cheaply.

Tools for Drilling and Milling a Lever

By Ralph N. Stryker

The lever shown at *A* in Fig. 1 was to be drilled and milled as indicated. The drilling was done in the jig shown in Fig. 1. The jig consists of the steel base *B*, the bushing plate *C*, the supporting pins *D*, the locating pin *E*, the clamping screw *H*, the threaded bushing *J* and the necessary guide bushings.

To insert the lever, the threaded bushing is raised and the clamping screw is backed out. The lever rests on the three supporting pins and is centered by the conical recess in the end of the threaded bushing engaging the hub around the large hole as the bushing is screwed down. The clamping screw is then tightened, forcing the angular face of the lever against the locating pin.

Slip bushings in the threaded bushing act as guide bushings for the drill and the reamer for the large hole. The other drill bushings are disposed as shown.

In Fig. 2 is shown the milling fixture. It consists of the base plate *A* which is provided with keys *B* for locating it by entering the slot in the machine table; locating pins *C* and *D*; and the clamp *E*. The lever is located by the locating pins entering two of the holes and is securely held by the clamp. The locating pins hold the lever in the proper position for milling the slot at an angle of 37½ degrees.

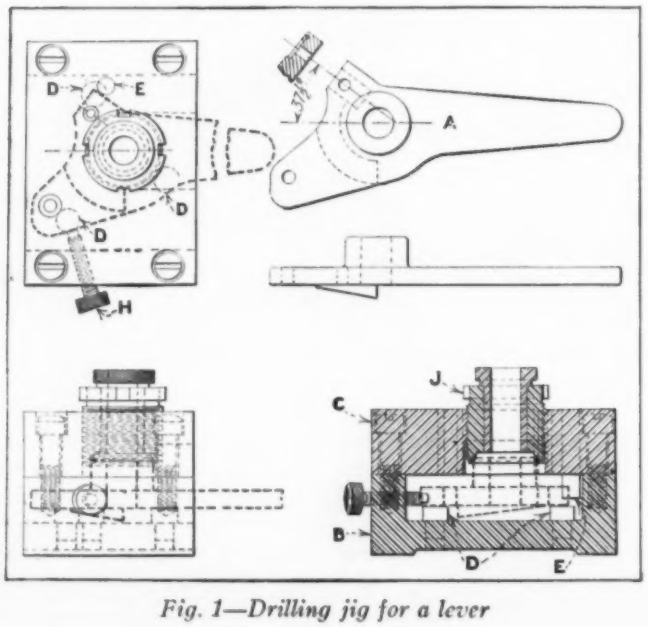


Fig. 1—Drilling jig for a lever

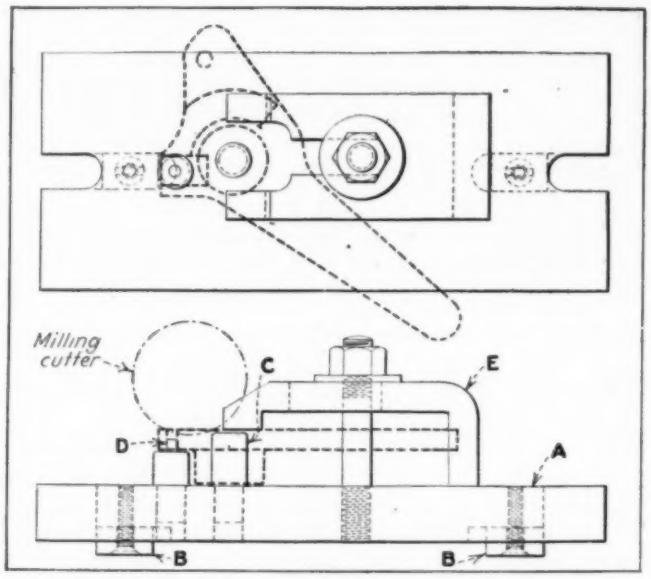


Fig. 2—Fixture for milling an angular slot

It will be noticed that the lever is placed with opposite sides upward in the jig and the fixture, respectively. The reversal is because in the drill jig the boss side is placed uppermost so that it can be centered by the threaded bushing. In this position the side to be milled is underneath and the lever must be reversed to bring it on top.

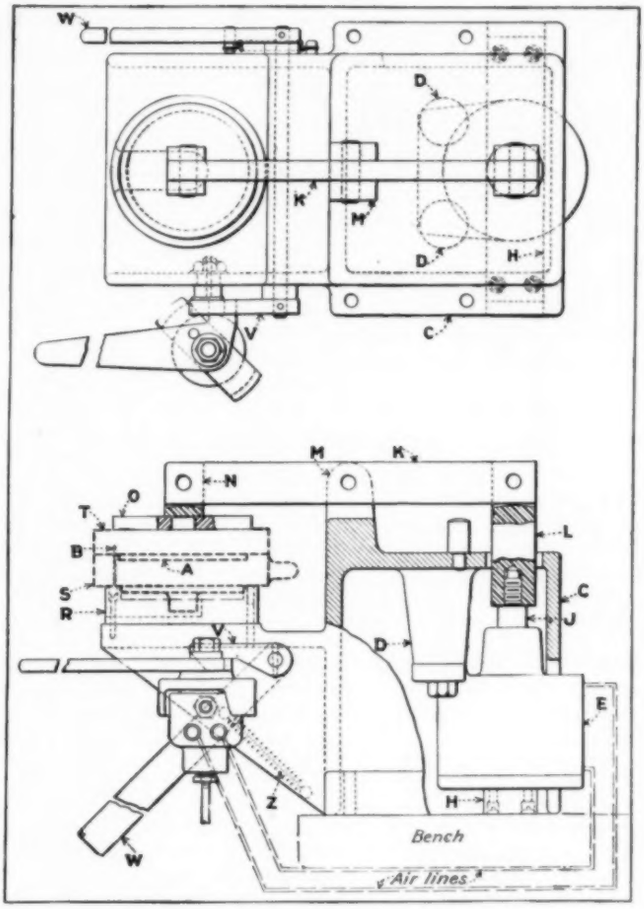
An Air-Operated Assembling Fixture

By B. J. Stern

An air-operated fixture for assembling and holding two finished castings for final operations is illustrated in the sketch. The shoulder *A* on the upper casting shown in the heavy dotted lines is a light press fit in the corresponding groove in the lower casting, the small pin *B* in the lower casting serving to align the two. After being pressed together, an opening in the assembly is hand scraped and other members of the finished product are then screwed into place on the castings, making a sub-assembly. All this was formerly done in a vise, but it proved to be a slow and clumsy method, thereby leading to the development shown in the illustration.

The base casting *C* is bolted to a bench as shown. On the boss *D*, inside the main frame of the casting, is screwed the air cylinder *E*, the plate *H*, which fits and is screwed in a slot cut in the frame bottom, acting as a backing for the cylinder. The piston rod *J* is connected to the lever *K* by the link *L*. The lever *K* is fulcrumed in the casting lugs *M*. Connected to the work end of this lever is the yoke *N*, free to swing on a pin in the lever. The plate *O* is connected to this yoke. The table extension of the main casting lies directly underneath the work end of the lever. On the table is screwed and dowelled the ring *R* in which is located the bottom casting *S*.

The two finished castings *S* and *J* are first placed together by the operator, after which they are positioned



Details of the fixture

in the locating ring *R*. The air pressure is now applied to the piston by opening an air valve fastened to the side of the table extension. In order to protect the operator, the handle of the valve cannot be moved until the latch *V* is lifted, this latch engaging a lip on the valve handle. The latch is pinned to a shaft extending to the handle *W* on the side opposite to the one on which the valve is located. It is, therefore, necessary for the operator to use his left hand in order to lift the handle *W* against the pressure of the spring *Z*, thereby lifting the latch from the path of the air-valve lever, which can then be moved by the right hand of the operator.

As air is admitted to the cylinder, the lever forces down the plate *O* on the castings, pressing them together.

Eliminating Corrosion on Welding Jaws

By George H. Feltner

Among the many industrial uses for chromium plating is the surfacing of copper contact jaws used in connection with butt-welding. Not long ago I visited a shop where an operation of this kind was being performed and the jaws corroded so rapidly that it was necessary to remove them twice a day for cleaning purposes. On a more recent visit, I asked the superintendent how the job was coming along and he said, "We have it licked." What had been done was to chromium plate the faces of the jaws, depositing approximately 0.005 in. thereon, with the result that they now hold up more than two weeks. Before plating the jaws the faces were polished smoothly, so that after the chromium was applied the corrosion had little chance to form.

Practical Shop Problems

Questions of a Practical Nature will be answered in this column

Cost Keeping on Production Machines

Q. We are looking for information relative to the method of cost keeping on production machines where an operator is running more than one machine. What is the usual manner of cost finding and billing where the operations are grouped?

A. One of the very large plants that has been grouping machines operating on different classes of work gives us the following answer to this question: "In answer to the question of how costs are apportioned where the operator is running more than one machine, we establish a task and a piece-work price for each operation rather than a piece-work price for a group of operations, and it so happens that if a man is attending several machines producing work which is not chargeable to the same account, it is necessary to use a separate time ticket for each operation in order that costs may be properly collected. As regards grouping machines as a task for the operator, we, of course, strive for high machine output as well as man output, and we plan, therefore, for an operator to attend as many machines as he can without creating too great a risk of fatigue and loss of quality."

We believe that this firm's policy is an approved method. When the time-study is made, the study is of one machine, with one operation, remembering that the operator handles the other machines during the waiting time on the one machine. The task rate is therefore set on the possibilities of the operating time of the machine, not counting the waiting time. In actual practice, if one machine of the group is broken down, the operator is paid a partial day-rate, based on the proportionate operating time of that particular machine. This day rate is charged on the time card pertaining to that machine.

But where the group of machines is working on progressive operations there is usually no need for separate costs. Moreover, in such a set-up the breaking down of one operation will naturally tie up the others.

Cleaning Leather Belts—*Discussion*

By Wm. J. Fisher, Jr.

On page 944, Vol. 66, of the *American Machinist*, some one asked how to take oil out of a belt that had become so saturated that the belt had lost most of its efficiency. We have in our plant nearly 3,000 belts, many of them running close to line-shaft bearings where the belts become at least partly saturated with machine oil. When this happens we take the belt off and put it in an iron tank with enough gasoline to cover the belt, letting it stay until the oil is absorbed by the gasoline, which is, of course, a good solvent of oil. The belt is then taken out and put in a dry place in a loose coil, taking care that it is not in a closed room or near an open flame. It is best to put it outside if the weather is clear. Only a very short time will be necessary for the drying operation. It can then be put back in place, and a light dressing of neatsfoot oil will put it in good shape for driving purposes.

Technical Abstracts

Industrial Application of Chromium Plating

It was not until 1920 that chromium plating became a commercial process. Since that time chromium has found a widespread application in many branches of industry, and is replacing nickel and other metals for plating where an especially hard corrosion-resisting surface is required. Dies, molds, machine parts, cutlery, automobile fittings, trays and containers are but a few of the articles to which chromium plating has been applied.

There is a widespread belief that chromium plating is beset with great difficulties, but it is in fact a comparatively simple operation. If certain definite conditions are fulfilled, there is no reason why an ordinary plater cannot chromium plate articles without any special electrochemical knowledge. The following factors are primarily involved: 1. Composition of the electrolyte; 2. Concentration of the electrolyte; 3. Addition of a compound to form chromium chromate; 4. Condition of the base metal; 5. Inter-relation of temperature and current density. One of the best working solutions is: Chromic acid, 250 grams; chromium sulphate, 5 grams; and chromium carbonate, 7 grams. That the whole question of chromium plating is still in an embryotic condition is shown by a recent publication of the Bureau of Standards, in which it no longer advises the addition of materials to chromium electrolytes that are likely to produce chromium chromate in the solution. It claims that the deposits from such solutions are identical with those from electrolytes containing only chromic acid and sulphuric acid, and that the materials added to produce the chromium chromate are very often objectionable.

Before attempting to plate chromium, it is essential that the article be free from every trace of oil and grease, or the chromium will not adhere to the work, and may show dark patches. Bright deposits of chromium can only be secured within a narrow range of temperature and current density. The most effective temperature range lies between 104 and 122 deg. F. The most effective current density range is between 50 and 200 amperes per sq.ft. Within these ranges good deposits are secured at high temperatures and low current densities, or high current densities and low temperatures. The amount of the deposit increases with current density, but decreases with rise in temperature. For general industrial purposes the best current density is 100 amperes per square foot with a temperature of 113 deg. F. Thermostatic control of temperature is desirable, although a fluctuation of 1 or 2 degrees is not considered harmful.

Inert anodes, such as lead, are usually employed in plating with chromium, the depleted metal content of the bath being replaced by periodic additions of the constituents. Milk-like deposits are an indication that the current density is too high or the temperature too low. Scanty grayish-blue deposits indicate that the temperature is too low, and the current density too high. If the deposit does not adhere firmly to the surface of the base metal, it is probably a sign that grease or oil are present. The use of one of the special commercial cleaning agents will eliminate defects of this character and assure better results.

Chromium plating has very serious limitations and drawbacks which make its general application to replace nickel plating highly improbable. The "throwing power" of chromium electrolytes is poor, the current efficiency low, and the cost of installing high-power generators is a serious consideration where it is necessary to handle a large quantity of work at one time. Moreover, the porosity of chromium plating causes inadequate protection of the steel unless a layer of copper, or copper and nickel, be first deposited. Plating operations are also beset with difficulties, as the fumes from the bath are highly corrosive and attack the nose and throat of the worker.—*Houghton's Black and White*, November, 1927.

Method in a Belgian Automotive Factory

The plant of the Fabrique-Nationale d'Armes de Guerre, commonly known as the F. N. Company, is located at Herstal, Belgium. Although originally established in 1889 for the manufacture of fire arms, it began to make bicycles and motorcycles in 1900, and has since developed a line of small automobiles. The plant covers about 53 acres and has 6,000 employees, of which approximately 2,500 are engaged on automobile and motorcycle work. The power house generates 6,000 hp., and there are 6,500 machine tools of all types in the plant.

The relatively small output does not permit the use of the line system of progressive manufacture, and the jigs, fixtures and machine tools are designed and selected for accuracy rather than for heavy duty or the utmost efficiency in production. The work is handled in lots, and the machine tools are grouped according to types, except in the case of the heaviest components, such as cylinder blocks and other motor parts. An attempt has been made to group the plant in sections for each component, although the machines are not in all cases arranged in the order of the operations to be performed.

Rigorous scientific and technical control is exercised throughout the plant, beginning with the raw material inspection department. Here Brinell tests are made of all material received, and the use of etched and polished sections are used to disclose the condition of the material used in forgings and similar parts.

The shops are of modern construction, largely of the saw-tooth type, and the equipment, while not of the latest high production type, is of fairly recent design and includes Belgian, French, German, American, and a small proportion of English machines. The automatics are mainly of the Gridley multi-spindle type, and are mostly operated by women under the supervision of tool-setters. Most of the work is done on a piece-work basis, the exception being components where unusual care and accuracy are necessary. The gear-cutting equipment includes Pfauter hobbing machines, Fellows gear shapers, and a number of Gleason spiral bevel gear generators.—*The Automobile Engineer*, November, 1927.

Coating by Spraying with Molten Metal

The metal to be deposited is used in the form of ordinary commercial wire. The wire is fed automatically from a reel into the nozzle of the metal-spraying tool, or torch, where it comes into contact with an oxy-acetylene flame which melts it and, in combination with compressed air, blows the atomized metal against the surface being coated at a velocity of about 3,000 ft. per second. The metal as it impinges against the surface at this high velocity solidifies and practically becomes an integral part of it, as indicated by the fact that it cannot be separated from the surface either by severe hammering or by the usual bending tests.

The process is used both to enlarge cylindrical parts, as it can be applied to work in the lathe, and to give a coating that will withstand corrosion. Large dry dock gates have been so treated.

The torch is connected by a rubber hose to standard acetylene and oxygen cylinders and also to a supply of compressed air. The wire is fed to the flame at a rate varying from 12 to 24 ft. per min., depending upon the kind of metal of which it is composed. About 15 cu.ft. of gas is consumed per hour, and approximately 50 cu.ft. of compressed air per minute at a pressure of 50 lb. per sq.inch.—Richard L. Binder, *Machinery*, November.

Characteristics of Nitralloy

Nitralloy is the trade name of a group of special alloy steels that can be surface hardened by subjecting to the action of ammonia gas for a period of from two to ninety hours, depending upon the depth of the hardened case desired. This treatment is given while the steel is heated to a temperature of approximately 875 deg. F., and it is not subsequently quenched. In ordinary casehardening, steels must be heated to high temperatures, followed by subsequent quenching, in order to develop a hardened case. By the nitriding process, however, the deformation resulting from ordinary casehardening is avoided, and a hardened case is obtained that will scratch glass, and one which offers great resistance to metal-to-metal wear.

Nitralloy represents a group of steels of special analysis for use in the nitriding process. Nitralloy can be forged readily, and machined easily in the annealed condition. The addition of a percentage of aluminum in all types of Nitralloy is considered indispensable, because of the extreme hardness which this element imparts to the surface of the steel when nitrided in the ammonia gas, and also because of the physical properties produced in the core. Carbon is contained in the steel, but has no influence on the casehardening process. It is included only for its effect upon the physical properties of the core. The accompanying tables show typical analyses of different grades of Nitralloy.

The manufacture of parts from Nitralloy does not differ materially from the shop methods commonly employed. Where high physical properties are necessary, an oil quench and draw are used, as is customary in the treatment of alloy steel. While the surface hardening by the nitriding process does not cause distortion of the part treated, it nevertheless does not correct rolling, forging, or machining strains previously set up. For this purpose, an anneal at 1,000 deg. F. for about five hours, prior to the nitriding, must be used to secure good results.

The Nitralloy steels forge as easily as ordinary alloy steels of the same carbon content. Grinding or lapping before nitriding offers no difficulty, but these operations are very difficult if done after nitriding, because of the extreme hardness of the case. The rough and finish machining operations do not differ from existing shop routine if the piece is given an anneal.

The nitriding operation is preferably carried out in an electric furnace where the temperature can be closely controlled at about 875 deg. F. The parts to be nitrided are placed in a gas-tight box, provided with inlet and outlet tubes for the circulation of the ammonia gas. The parts to be hardened are loosely placed in the box without any packing material, but the individual layers are separated by nickel wire netting, so as to permit of free circulation of the gas.

The rate of flow of the gas is regulated by the needle valve supplied with the ammonia cylinder, which is connected by tubing to the inlet pipe of the nitriding box. The two essential requirements of the nitriding process are to keep the flow of ammonia fairly constant during the entire cycle, and to hold the temperature steady. At the end of the nitriding operation, the ammonia is shut off, the inlet and outlet tubes short-circuited by a piece of rubber tubing, and the box is pulled out of the furnace. The ammonia is then reconnected, and the box allowed to cool for 2 to 3 hours. For nitriding large quantities of material, a special retort-type of furnace is used.

Typical Nitralloy Analyses

Element	Grade A	Grade D	Grade C
Carbon	0.45	0.32	0.10
Manganese	0.60	0.60	0.60
Silicon	0.25	0.25	0.25
Aluminum	1.00	1.00	1.00
Chromium	1.60	1.70	1.65
Nickel	None	1.80	None
Sulphur	0.020	0.020	0.20
Phosphorous	0.020	0.020	0.20

The case produced by the full 90-hr. nitriding treatment is approximately 0.031 in. deep. About one-half of this case is of extreme hardness, but then the hardness decreases gradually until the case merges into the core without any line of demarcation. A typical specimen, nitrided at 875 deg. F., showed a Brinell hardness of 1.002 on the surface, 810 at a depth of 0.010, 434 Brinell at 0.020, and 378 Brinell at 0.030 in. The extreme hardness produced by nitriding is beyond the effective range of the usual methods of hardness testing. The results, therefore, are taken on the Herbert Pendulum Hardness Tester and converted into Brinnell figures.

The process involved in the nitriding of Nitralloy, is the decomposition of the ammonia gas by the heat into nitrogen and hydrogen, and the combination of the nitrogen with the metal, forming iron nitride. In the steels of special composition, other nitrides of extreme hardness are also formed in the process, chromium, for instance, giving a marked increase in hardness. When pieces come from the nitriding, they show a film of nitride on the surface, ranging in color from gray to yellow and violet. This film, however, is easily removed by abrasive paper. It is claimed to be of the utmost importance that steels of the proper composition be used for the nitriding process, and it was to fill these requirements that the Nitralloy steels were developed. Nitralloy of grade *A*, when drawn at 800 deg. F., gives an ultimate strength as high as 252,000 lb. per sq.in., with an elongation of 10.3 per cent in 2 in. In addition to high strength, toughness and extremely hard surface, Nitralloy steels are claimed to rank with the highest types of rustless materials in resistance to atmospheric and salt water corrosion.

For the information given we are indebted to the Ludlum Steel Company.

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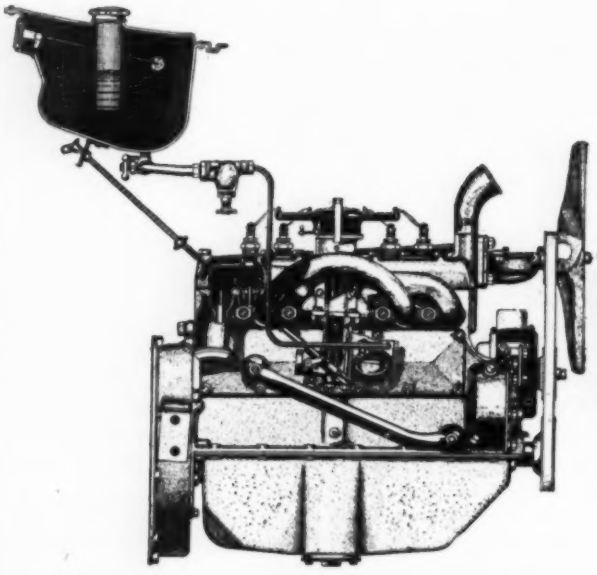
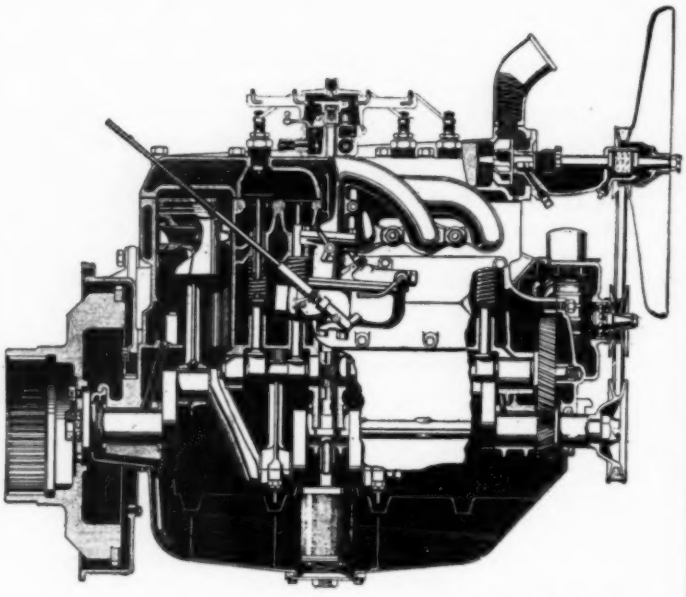
The New Ford

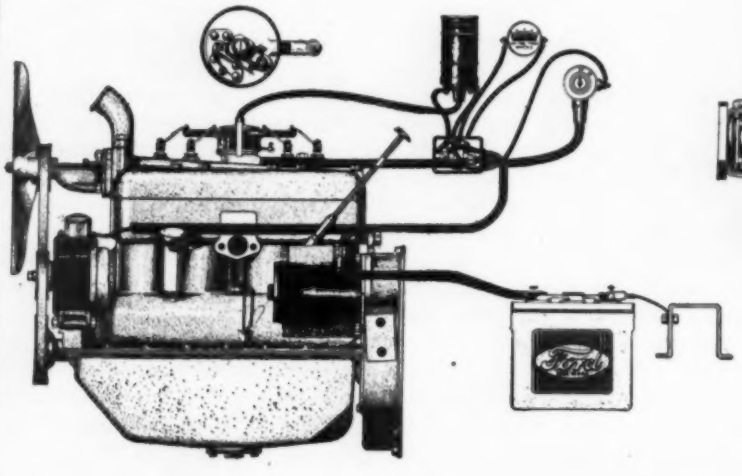


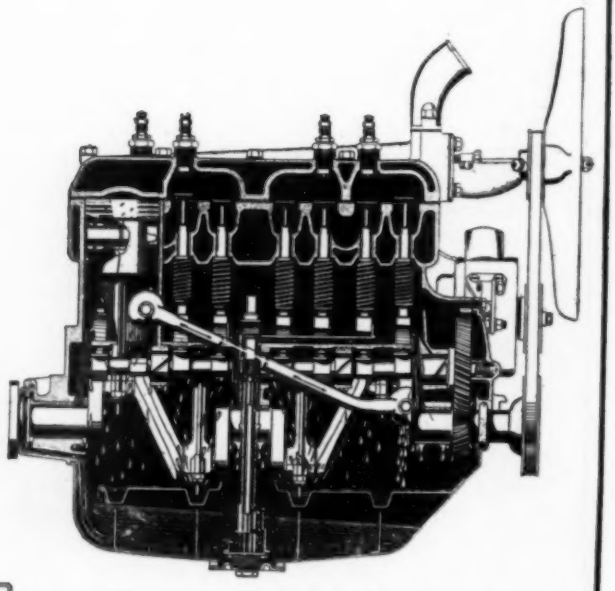
Fuel system. Gravity feed from tank in cowl with direct reading gasoline gage on instrument board. Choke and needle valve control as before. New manifolds. Cylinders 3¾x4¼ in. Hp. 40 at 2,200 r.p.m. Detachable head, deep crankcase



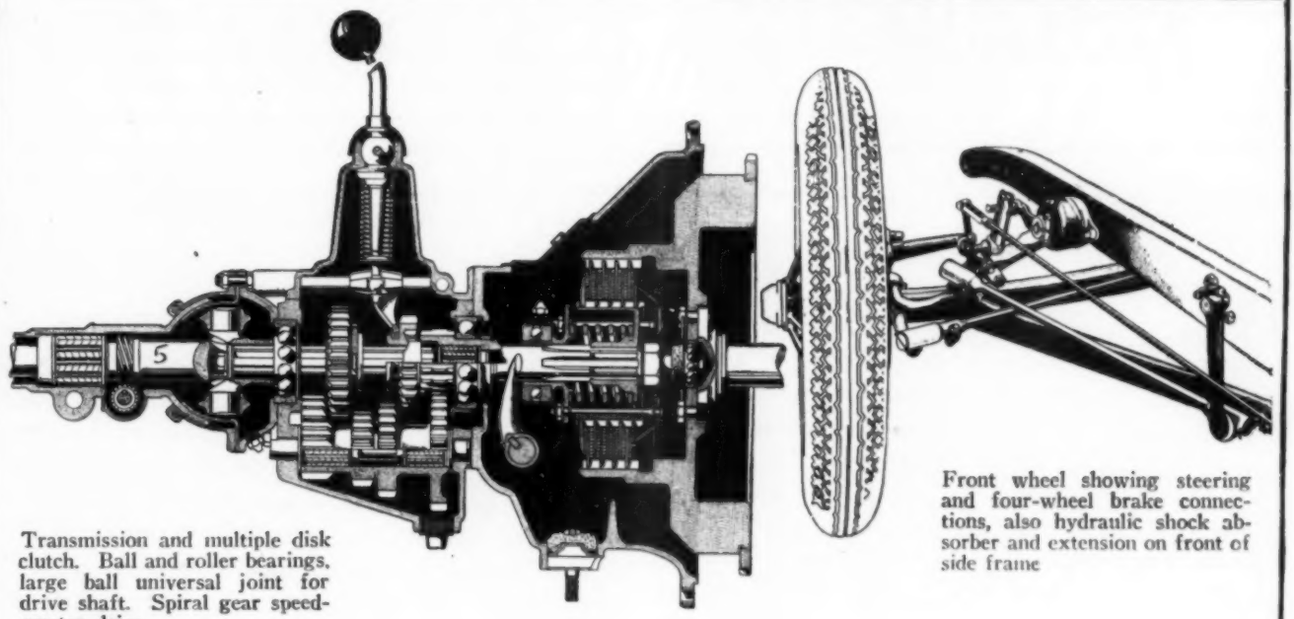
Engine details showing balanced crankshaft, oil filter and Bakelite timing gear. New generator. fan and water pump all driven from one V belt. Distributor on top of engine head with direct contact strips to spark plugs

Ignition system with distributor on top. Connections shown to coil, switch and ammeter. Switch connection is through a metal clad cable. New type of generator hinged for belt take-up. Two blade propellor type fan



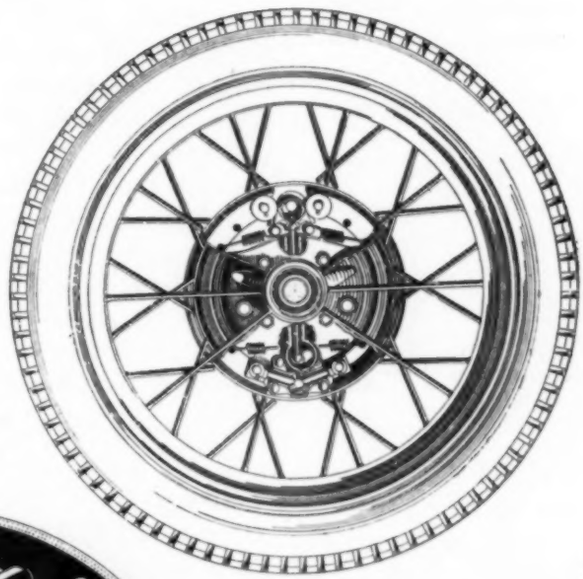


New lubrication system with geared pump inside of filter. Oil is pumped to chamber above camshaft and feeds by gravity to main bearings and to splash pans for connecting rods



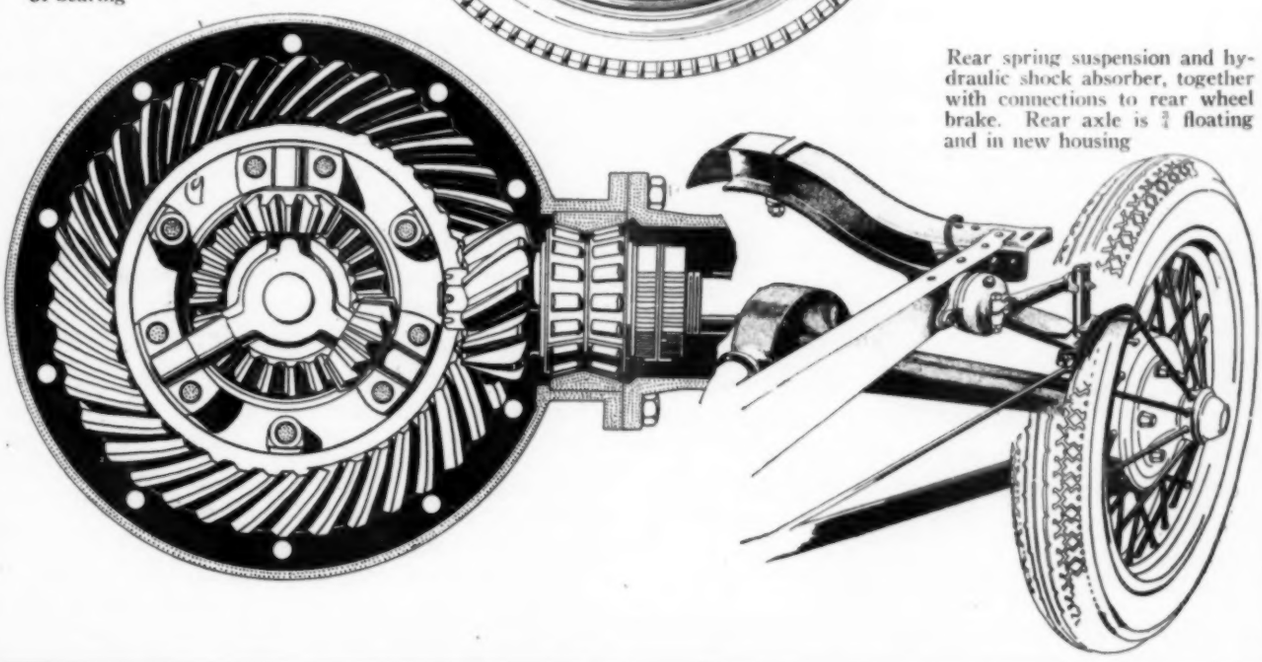
Transmission and multiple disk clutch. Ball and roller bearings, large ball universal joint for drive shaft. Spiral gear speedometer drive

Front wheel showing steering and four-wheel brake connections, also hydraulic shock absorber and extension on front of side frame



Front wheel and brake of internal, expanding type with 11-in. drum with lining 1¼ in. wide. Gives 168 sq.in. of total braking surface on the four wheels.

Rear axle drive and differential pinions. Spiral bevel gear drive, double Timken bearings. Pinion adjustable by nuts in front of bearing



Rear spring suspension and hydraulic shock absorber, together with connections to rear wheel brake. Rear axle is ¾ floating and in new housing

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

The Cost of Haggling

IF THE seller knew the real feelings of the average buyer toward those whose prices are subject to discounts that vary according to the pressure applied, his ego would frequently suffer a great shock. A large buyer of machinery told one of our friends sometime ago:

"I can do business with you quickly and satisfactorily because I know you have one price and that no argument of mine can change it. If all machine builders were like that, my job would be easier and take much less time. I've got to waste an hour or two this afternoon getting one builder to name his *real* price. He thinks it's good business to try to get more than he's willing to take. So I know I can't trust him and it wastes his time and mine."

This builder would probably not be happy at the buyer's opinion of him, or believe that anyone could get his "asking" price from the buyer, who is "hard-boiled" to him. Yet there are probably many buyers who feel the same way and who have been forced into the "hard-boiled" class by finding that others were buying for less money than they.

What Price Progress?

INVENTION of a new device has its difficulties, but the real problem is in its development and marketing. It is easy enough to say that if the device is really worthy, there should be no trouble in getting it adopted. But the history of nearly every great invention disproves this popular idea. Could there be a better example of this than the case of Bell and his telephone?

Assume that an inventor of known repute devises a new type of internal combustion engine that is so radical as to change our whole ideas and practice of automotive engines. Its introduction would be a difficult and costly task because of the millions invested in machinery, equipment and fixtures for building the standard engine. And how much more difficult would it be for the unknown inventor?

The introduction of radically new devices is a real problem. For even if the inventor has money enough of his own, or his friends help him to develop his new engine, how will he get it into actual use? The whole world perhaps must forego the advantages of the new invention for a long period. But is there any feasible plan by which such new devices could always be developed and introduced without their benefit being counteracted by the cost of scrapping much that is now in use? Who has the panacea?

Health Adds to Prosperity

EVIDENCE is accumulating that the effect of health on output, accidents and trade is more than we had appreciated. High blood pressure, defective eyesight and poor illumination are given as causes for accidents, lowered output and work of inferior quality. One authority traces 24 per cent of shop accidents to poor lighting.

Dr. Otto Geier of Cincinnati recently advocated that manufacturers give more thought to medical attention for their employees, at home as well as in the shop, for economic as well as humanitarian reasons. Sickness in the family as well as his own ailments interferes with a man's work.

Beyond lies the effect of illness on the buying power of the worker's family. Money that would go into general trade, perhaps to buy some of the articles he helps to make, is diverted to other channels. Though illness demands medicines and other articles that enter into trade, it depletes savings and involves loss of output.

Health and safety are national assets.

The Need for Small Aviation Engines

COMMERCIAL and private aviation is developing more rapidly than even some of its advocates believed possible a few years ago. There are many good planes being built and in many different shops. There is, however, a dearth of aviation engines in the smaller powers. The old Curtiss OX-5, that served so long and well, has not been in production for several years.

Planes are waiting for small engines of 60-70 hp. but the engines are not forthcoming, although a few are being built. Engines of 100 to 120 hp. will probably be in even greater demand.

This is not a suggestion that a large number of firms jump into the airplane engine field, for the problem is difficult and not to be solved by novices. Light weight, accuracy, durability and particularly reliability are absolutely essential. It is hard to find a field for careful and conscientious development that is more promising.

Shop Equipment News

Cincinnati "Giant Hydromatic" Automatic Milling Machines—*Erratum*

[*Due to the transposition of linotype slugs in correcting lines in the article published in last week's issue of* American Machinist, *under the above title, the sense of the opening paragraph was lost. That paragraph, corrected, and the four paragraphs that followed it in the original article are reprinted here. Of the illustrations referred to, only Fig. 6 is included in this correction.*]

RECIPROCATION of the table by hydraulic means is featured in the "Giant Hydromatic" milling machines recently developed by the Cincinnati Milling Machine Company, Cincinnati, Ohio. Among the operating characteristics obtained are: reciprocation in either direction at normal feeding rates or at rapid traverse rate; positive control of the feeding movement regardless of the direction or amount of the resultant cutting force; positive lock of the table in the stopped position, thus rendering it incapable of movement under the action of the cutter; the ability for accurate reversal under any cutting conditions; readily controlled acceleration and deceleration of the feed rate during a cut; and economical operation. Two views of the standard unit are shown in Figs. 1 and 2, while Fig. 3 shows a duplex model.

These operating characteristics have been obtained by the use of a special combination of pump and auxiliary devices arranged to provide a locked control system. In Figs. 4 and 5, the standard hydraulic feed pump unit is shown, while Fig. 6 shows in simple diagrammatic form the arrangement of the elements involved in the feeding circuit only. Cylinder *C* is securely bolted to the bed and carries a sliding piston *P* connected to the table by a substantial piston rod. Part *V* is a reversing valve. The booster pump is a small high-pressure pump that works in conjunction with the Oilgear variable-displacement pump to produce a continued forward pressure on the piston. The amount of the pressure is determined by the setting of the relief valve *R*. The space within the cylinder on both sides of the piston is at all times completely filled with oil; consequently, in order that the piston may be moved in a given direction by means of the forward pressure, it is necessary that the oil on the other side be able to escape.

If no escape is permitted, there will be no movement of the piston. If some escape is permitted, then the piston will advance just as fast as the escaping oil will allow it, and, with a positively controlled escapement, the

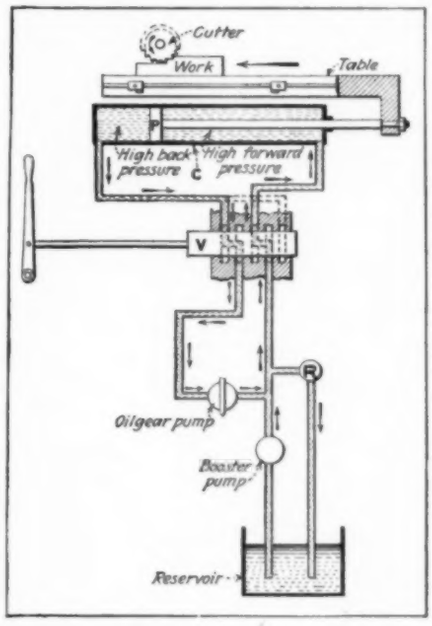


Fig. 6—The hydraulic feed circuit in diagrammatic form

rate of advance is virtually independent of the amount of forward pressure applied.

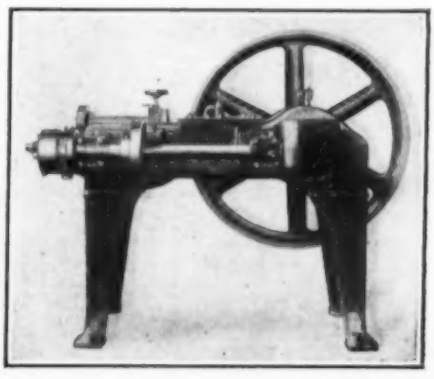
From Fig. 6 it is evident that the only avenue of escape for the oil from the rear end of the cylinder is by way of the pipe through the reversing valve and thence through the Oilgear pump. Consequently, the quantity of oil permitted to escape from the cylinder is definitely fixed by the displacement of the Oilgear pump. As the displacement of this pump may be varied at will from zero to maximum, the forward rate of the table may likewise be varied. With this system a constantly receding restraint, or back pressure, is provided.

The amount of this back pressure is not constant but varies with the direction and amount of the resultant cutting force. The circuit described above pertains to a movement of the table at feeding rates only. In order to provide, in addition, a high table feed for rapid approach to the work and rapid return, use is made of an auxiliary large-volume, low-pressure gear pump. This is connected in the same circuit as the feed and is operated by a common control or selector valve. This valve is arranged to give both a reversal of table movement and a change of speed from feed rate to rapid traverse, or vice versa. The valve has both reciprocatory and oscillatory motion.

Manville Automatic Wire-Forming and Swaging Machine

An automatic machine to cut off, swage, and bend, or form, wire into various shapes has been brought out recently by the E. J. Manville Machine Company, Waterbury, Conn. It is made in two sizes, with capacities for wire of $\frac{5}{32}$ and $\frac{1}{4}$ in. in diameter.

The mechanism comprises a roll-feed, actuated by a ratchet with adjustable stroke to feed the wire from a reel or coil at the side of the machine; a cut-off; a transfer slide to carry the cut length of wire to the tools; a ram, or gate, in which the swaging tools are secured; and means



Manville Wire-Forming and Swaging Machine

Shop Equipment News

to bend or form the cut wire into any desired shape within the capacity of the machine.

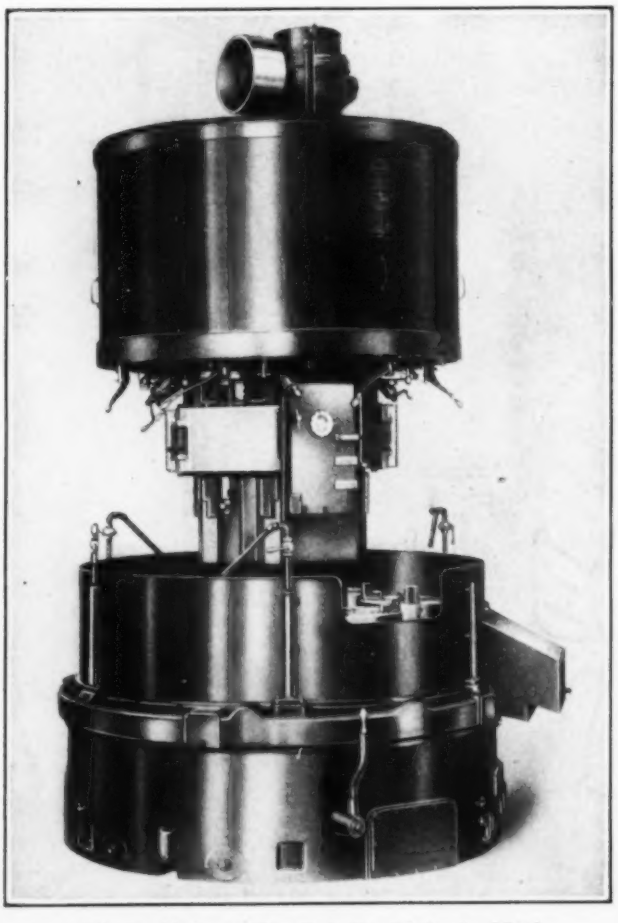
Though designed primarily for the manufacture of tongues for buckles and similar parts, the shape of the product is determined almost wholly by the tools with which the slides are provided, and the machine is, therefore, adaptable to a large variety of parts that can be made of soft wire.

The No. 1 machine occupies a floor space of 36x66 in., and weighs 400 lb. The No. 2 machine covers a space of 40x73 in., and its weight is 700 pounds.

Bullard 20-Inch Six-Spindle Mult-Au-Matic

COMPLETE coverage within the range of capacity wherein sufficient quantity of work exists to justify this type of equipment is now available with the addition of the 20-in. machine to the line of six-spindle Mult-Au-Matics put out by the Bullard Machine Tool Company, Bridgeport, Conn. The complete line is now made in 8-, 12-, 16- and 20-in. sizes. The additional size extends he application of the method to larger work in which there are fewer opportunities for continuous production, but where there is a greater margin of economy on shorter runs and more frequent changes of set-up, than on smaller work. This 20-in. model provides a clear swing of work 21½ in. in diameter at 8 in. above the chuck face and 12 in. in diameter for chucked work extending 17 in. high. The work is chucked by the operator at the loading station, is periodically indexed through each of the five working stations for the respective operations and finally returned for unloading. As usual, six pieces are in process at the same time. At the loading station there is a power-driven, chuck-operating unit, which connects with the respective spindles as they are presented in this position. It may also be used to operate various special forms of work-holding devices that may be attached to the face of the spindle.

The tool heads provided at the five working stations may be of plain, compound, standard universal, or double-purpose type providing, respectively, vertical, horizontal, angular, or a combination of vertical and horizontal tool traverse and feed. The full stroke of the head comprises 8⅛ in. of primary vertical movement, which, in the compound head, may be transformed to 4⅛ in. vertical and 4 in. horizontal movement. In the standard universal head, the horizontal or angular travel of the head is 3 in. and the vertical motion 5⅛ in. The double-purpose head also provides 5⅛ in. vertical primary movement, and 3 in. secondary movement for vertical and horizontal slide traverse.



Bullard 20-Inch Six-Spindle Mult-Au-Matic

The available spindle speeds may be independently obtained at each station and range from 5.3 to 131.7 r.p.m. in 25 steps. The tool feeds, independently variable for each head, range from 0.0030 to 0.1294 in. per revolution, in 19 changes.

The general construction of the 20-in. Mult-Au-Matic is similar in practically all details to the other sizes, except of course, that the size permits a heavier construction so that heavier cuts can be taken. The general design includes a circular base-plate 81 in. in diameter, properly reinforced for rigidity and containing the reservoirs for lubricating oil and cutting compound with the respective pumps for circulation. The central column rising from this base provides on the lower portion an ample bearing for the work-spindle carrier, and in the hexagon upper section, face bearings for mounting the tool heads. The sixth face has an opening for access to gears and shafts within the column. This column supports an upper feed works base and the feed works units in the upper compartment.

The work spindle carrier and the spindles themselves are typical Bullard design: the six spindles are placed equi-distant from each other and radially about the central column, each spindle registering under the tool heads at each of the working stations and at the loading station. The upper compartment contains the individual feed works as well as the centralized clutch and drive unit with indexing control.

The machine can be arranged for either direct motor drive or belt drive. Under average conditions a 15-hp. motor is required, and this may be mounted on top of the machine, if so desired.

For simplicity in operation and particularly in tool setting, a main clutch control lever is provided at each station and facilities for either power or hand operation of each tool head, independently, is also available. With this construction quick tool setting is accomplished.

Shop Equipment News

Bilton Pro-Ducto-Matic with Two-Spindle Angular Cutter Block

A COMPLETELY redesigned cutter block and head has just been arranged for the No. 46 Pro-Ducto-Matic milling machine by the Bilton Machine Tool Company, Bridgeport, Conn. The improved head, shown in Figs. 1 and 2, was designed especially for milling slots in automobile clutch plates at two different radii simultaneously, but the head can be used for any milling requiring 120-deg. indexing, or also for 50-deg. indexing. The base, turret, driving shaft and gear box are the same as furnished with the standard machine. The cutter block supporting knee is also the same as employed on the improved Pro-Ducto-Matic described on page 635, Vol. 67, of the *American Machinist*.

The cutter block, which carries the two vertical spindles, is arranged for lateral or vertical adjustment on the knee, in addition to which each spindle head is independently adjustable with micrometer screws. The movement of the head is governed in the regular way by the rocker arm working on a cam on the main shaft, but, in addition, two heavy coil springs are provided for balancing the movement of the head. To provide for quick changing, the cams are made in two sections, so that they can be readily changed on the shaft for different sizes of plates being milled.

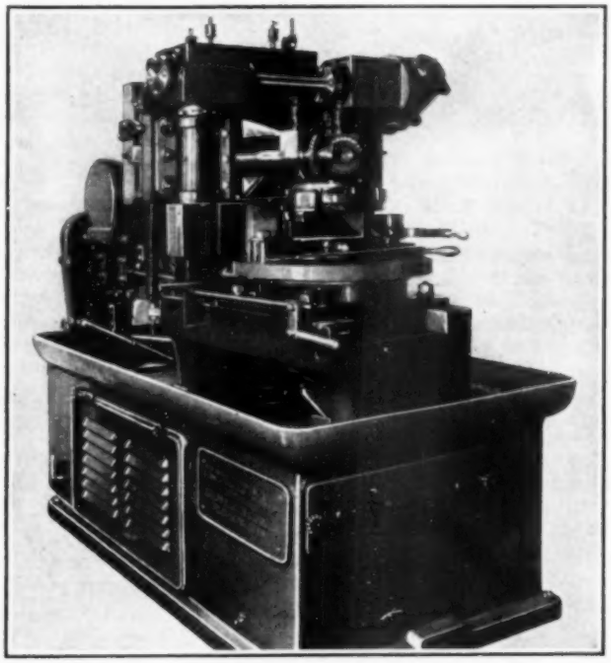


Fig. 1—Bilton Pro-Ducto-Matic with Two-Spindle Angular Cutter Block

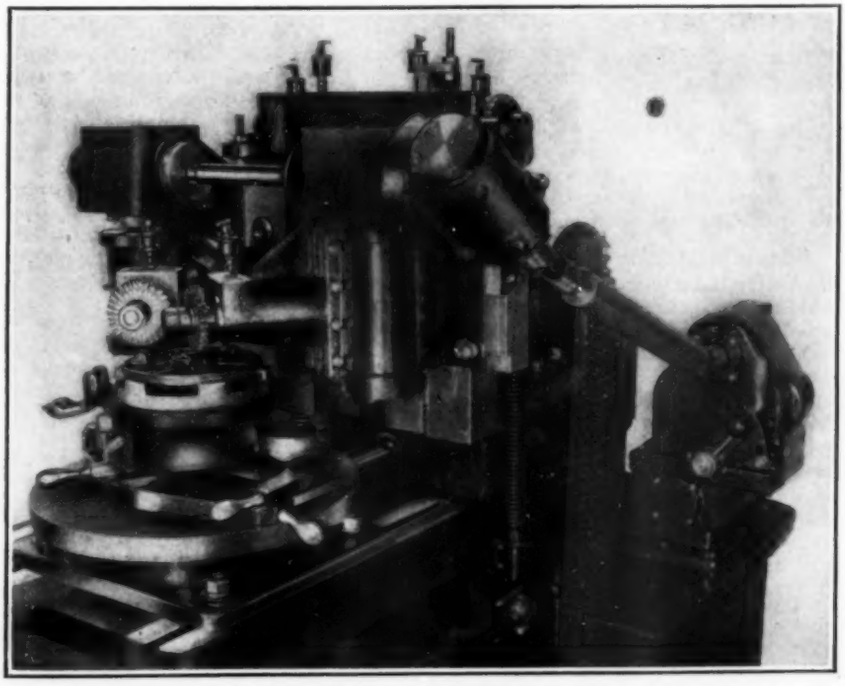


Fig. 2—Close-up view showing arrangement of spindle drive

The main drive from the gear box operates through spiral bevel gears to the intermediate shaft, which has a worm drive to a wormwheel on the cutter spindle. In adjusting the spindle for up and down movement, the wormwheel simply moves along the long worm in the intermediate shaft. Timken roller bearings are used, with ball-bearing thrusts against the bevel gears and on each side of the worms. The spindles are hardened and ground, with ground tapers. If required, for special work, one cutter head can be removed from the machine.

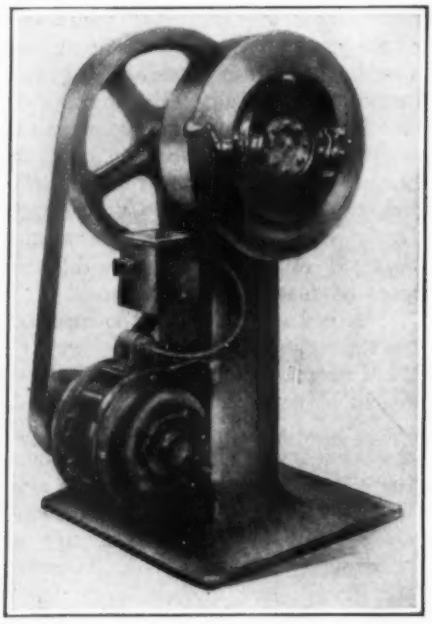
The machine in the illustration is shown with a special swinging jig for milling clutches. The jig swings out for loading and unloading, and is locked back in position with one movement of the lever. The starting control for feed is at the front of the machine, and other controls are within easy reach of the operator. The machine is arranged for the operation of more than one unit by one workman.

The universal principle has been retained by making all parts standard except the knee and cutter head. In case of abandoning the job set-up, therefore, the machine can be readily changed over to an automatic milling machine by acquiring these two units. Or the cutter block alone can be changed for castellating nuts and similar milling work.

Dayton-Torrington Improved 4-Die Swaging Machine

Slightly increased capacity is now available on the No. 3 size of the Dayton 4-die swaging machine made by the Torrington Company, Torrington, Conn. The present capacity on solid stock is $\frac{1}{2}$ in. and on tubular stock it is $\frac{3}{4}$ in. The complete line of 4-die swaging machine, in sizes

Shop Equipment News



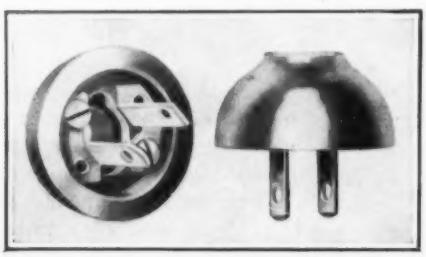
Dayton-Torrington Improved 4-Die Swaging Machine

No. 3, 3½ and 4 were described on page 79, Vol. 62, of the *American Machinist*.

In the illustration the machine is shown equipped with a motor mounted on the side of the pedestal, driving by belt with an idler tightener. The machine may also be supplied without a motor in which case the drive is from an overhead countershaft.

Cutler-Hammer Unbreakable Plug

An unbreakable attachment plug made of rubber is announced by the Cutler-Hammer Manufacturing Company, 611 12th St., Milwaukee, Wis. The plug is made of a high grade of rubber and is light in weight. The terminals are fastened in a Bakelite strip firmly embedded in the rubber base. Rivet and anchor construction is used to hold the terminals to the Bakelite to keep them from turning.



Cutler-Hammer Unbreakable Plug

Staked screws prevent loss and save time in wiring.

When the plug is used with rubber cord, it is easy to relieve the strain between the cord and plug by cementing the rubber covering into the plug.

Trade Catalogs

BALL BEARINGS. The Suspension Bearing Co., Spartanburg, S. C., has issued a small catalog containing load ratings and dimensions for grooved and plain ball thrust bearings. Flat steel thrust washers are also listed.

BALL AND ROLLER BEARINGS. The RBF Ball Bearing Co., 33 West 60th St., New York, N. Y., recently published general catalog No. 9 covering its products. A general description of the manufacture of the bearings is first given, followed by tables of load ratings and dimensions of the various series. The line includes deep-groove bearings, with both plain and self-aligning outer races, of the light, medium, and heavy-duty series, angular contact bearings, double-row deep-groove bearings, and an adapter type series. The company also makes a line of cylindrical roller bearings, ball-bearing pillow blocks and hangers, and a complete series of thrust bearings. The catalog is illustrated with photographs and cross-sectional line cuts. It has 64 6x8½-in. pages.

BELTS. The Chas. A. Schieran Co., 30 Ferry St., New York, N. Y., has issued a descriptive circular showing how its belts are spliced so that they will not pull apart. The leaflet is well illustrated.

BENDING MACHINE. The Hossfeld Manufacturing Co., Winona, Minn., describes in an illustrated leaflet, its universal iron bender. Typical applications are described and illustrated such as bending pipe and conduit, U-shaped eyebolts, rings, and angles. A list of users of this equipment is included.

BRAKES, MAGNETIC. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has issued a booklet entitled "When Industry Says Stop." It covers this company's line of a.c. and d.c. magnetic brakes and explains in detail the construction and operation of all types. In addition, the booklet contains tables showing the size and type of brakes for use with the various types of mill and crane motors. The publication is well-illustrated.

CHUCKS FOR SEGMENTAL WHEELS. The Norton Co., Worcester, Mass., describes in a small booklet, the Norton chuck for segmental wheels used on Blanchard surface grinding machines. The construction of the chuck and its segments are first described, followed by an exposition of the advantages of this type of chuck and segments. A table showing the various grades of stone and their uses is appended.

GRINDING MACHINERY. The Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn., announces a loose-leaf catalog in which are described and illustrated the more popular machines of the "Bridgeport" line. A considerable portion of the book is devoted to grinding wheels, and in order to show the various shapes, the presentation is largely pictorial. Various styles of face and knife grinders are shown, as well as motor-driven floor grinders and similar equipment. Complete descriptions and specifications are given for each machine, which is illustrated by a photograph.

GRINDING MACHINES, SPLINE. The Gear Grinding Machine Co., Detroit, Mich., has issued an illustrated leaflet describing its type S-G-9 spline grinding machine. The gear grinding and testing equipment made by this company is also illustrated. The details of the construction and operation of the unit are given.

HEAT-TREATING FURNACES. The W. S. Rockwell Co., 50 Church St., New York, N. Y., has published circular No. 285 describing the car and car-and-roll type furnace for the heat-treatment of metal. A technical description of the different forms of these furnaces and an outline of the field of usefulness and limitations of the different designs are included. The publication is in leaflet form, perforated for insertion in a loose-leaf binder, and is illustrated with cross-sectional views and photographs.

HEAT-TREATING FURNACES. The American Gas Furnace Co., Elizabeth, N. J., has issued a circular describing its gas-fired annealing and heat-treating furnaces. Each type is briefly described and illustrated by photographs.

MILLING MACHINES. The Ingersoll Milling Machine Co., Rockford, Ill., has prepared an illustrated leaflet showing some of its representative machines. The treatment is largely pictorial.

MILLING MACHINES. The Kearney & Trecker Corporation, Milwaukee, Wis., has published three catalogs on its milling machines. Catalog No. 27 treats of the No. 1 horizontal and vertical milling machines; Catalog No. 28, the No. 2 special horizontal and vertical milling machines; and Catalog No. 29, the No. 234 standard and heavy horizontal and vertical milling machines. The treatment in each case is similar. Each machine is completely analyzed in its major component, the descriptions being aided by numerous photographs of the various parts that enter into the machine. Complete specifications are given in every case.

NEWS OF THE WEEK

Hoover's Annual Report Shows General Prosperity for Year Ended July 1

Result of general and permanent progress in business

THE annual report of Secretary of Commerce Herbert Hoover, released on Dec. 2, contains some interesting facts on the economic progress of the United States in the fiscal year ended July 1. Mr. Hoover states that the year exceeded all previous records in volume of production and consumption, and in the physical quantity of exports and imports. There was very little unemployment, except during a moderate recession near the end of the year, and the rate of real wages remained higher than anywhere else in the world, or than at any other time in the world's history. The high prosperity of the year did not represent merely an upward swing in the business cycle, but was the result of that general and permanent progress the extent and causes of which are more fully set forth in the various sections of the report. There were a few aspects of American business which were less satisfactory, some of which were noticeable in the coal and textile industries, the relatively low price of cotton with its depressing effect upon the farmers of large regions of the South, and some continued depression in agriculture of the mid-West.

The volume of output in the manufacturing industries, by all odds the largest branch of productive activity, showed an appreciable gain even above the extremely high level of the fiscal year 1925-26. The improvement was not the result of an exceptionally marked increase in any particular field, but was general in practically every group of industries. The most conspicuous gains shown, as compared with 1925-26, are in mineral production, freight transportation, output of electric current, and sales of 5 and 10 cent stores. Electric current is being used in rapidly increasing quantities for lighting, for domestic power and heat, and above all for industrial power.

In the discussion of agriculture the situation of the farmer has an important bearing on the general trend of industry and commerce, according to the report. The crops harvested in the autumn of 1926, constituting the main factor in the agricultural situation of the fiscal year, were in the aggregate the largest produced in our history with the exceptions of the years 1915 and 1920. The output was approximately 2 per cent greater than in 1925.

The report states that the building and construction industries played a great part in the prosperity of the fiscal year. New construction undertaken in the fiscal year 1926-27, amounting to some seven billion dollars in value, constituted a powerful factor in maintaining general business activity and prosperity.

The physical volume of construction during this and the preceding year has exceeded even that of the years preceding the war. The value of contracts awarded was approximately the same in 1926-27 as in 1925-26, and exceeded the average for the two previous years by no less than 37 per cent.

Railway Efficiency Noted

During the last two fiscal years a conspicuous increase has occurred in the volume of railroad freight traffic even as compared with the high figures for the fiscal years 1924 and 1925. The ton-mileage of freight in 1925-26 was about 8 per cent greater than the year before, and 1926-27 showed a further increase of about 5½ per cent. This gain in traffic was accomplished with an insignificant addition to the number of employees, a fact indicating the continued advance in the efficiency of the railways which has been going on since the close of the war.

The financial markets are but briefly touched in this report. From the banking point of view, the fiscal year, like the calendar year, was one of sound but uneventful growth with ample money at low and stable rates. The rate of growth during the fiscal year seems, however, to have been somewhat slower than during the previous year. There was actually a perceptible degree of what would be termed "deflation" were our banks not on a thoroughly sound basis. Money in circulation diminished by nearly 2 per cent, deposits grew about twice as fast as loans, reserve ratios rose, and time deposits grew more rapidly than demand deposits.

Foreign trade, which is one of the principal phases of the Commerce Department, shows a very encouraging growth. The value of exports during the fiscal year 1926-27 was greater than in any other fiscal year since 1920-21, and when account is taken of the much lower price level, as compared with the war years, this past year was the greatest in our history. The increase in dollar value of domestic exports as compared with 1925-26 was about 4½ per cent, but prices were lower and the quantitative increase was in the neighborhood of 12 per cent. The decline in average prices of export commodities was in considerable part due to the sharp fall in cotton, but prices of many other exports showed more or less decrease.

There has been an extraordinary increase in the production of American industry during recent years with a consequent corresponding advance in the standards of living. This reflects not merely recovery from the dislocation caused by the war, nor from the low point of the post-war slump—it represents in large part an advance beyond the highest pre-war levels.

The basic causes of economic progress translate themselves into a number of more specific and directly working causes. Among these may be mentioned especially the advance in education, scientific research and invention; the growing use of mechanical power, machinery, and other forms of capital; the larger scale of production; the conscious and concerted effort to eliminate waste and reduce costs; the high scale of wages, with consequent general high buying power; and the relative stability of prices, money and credit.

Large Scale Production Grows

Industrial units in the United States are much larger than anywhere else in the world and are steadily growing in size. Manufacturing plants with an annual output exceeding $1,000,000 each represent only about 5 per cent of the total number of establishments, but they contribute two-thirds of the total value of factory products. Large-scale production is particularly conducive to low costs where processes are repetitive. Specialized machinery is used in such mass production, whereas with a smaller output it would be necessary to use machines designed for more general purposes, and less adapted to the particular task.

The work of the department in cooperation with industry and commerce in the elimination of waste has continued through the year. During the past fiscal year, simplified practice recommendations have been made in many industries.

In compliance with the new responsibilities assigned to the Department of Commerce by the passage of the Air Commerce Act of 1926, providing for the promotion and regulation of civil aeronautics, the department's first task was to organize aeronautical activities and select the necessary personnel. These activities were assigned to five divisions, all under the Director of Aeronautics and the Assistant Secretary of Commerce provided for in the new act. At the close of the fiscal year the total office personnel was 61, and the field personnel 161.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

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IN THE business history of America it is quite possible that last week may become known as Ford Week, for there is no denying that the advent of the new Ford car has greatly quickened the hope of an early change for the better in the outlook for trade and industry.

In Wall Street it is said that the term "Coolidge boom" which has been used to describe the advance of the past three years is no longer applicable; it is now the "Henry Ford market." More than 700 separate issues of stocks were dealt in on one day last week, while the total turnover of shares approximated the largest ever before reached and the general average of prices went through the previous high record.

Shares of companies which by any stretch of the imagination can be associated with Ford led in the advance, and even a rise in one of the railroads on which his Highland Park plant is situated was ascribed to the supposition that it will carry more material for the new car. Shares of the Ford Company of Canada—the only medium by which the public can participate in the Ford enterprises—rose to $725, which compares with the year's low of $393, and there were sharp advances also in the stocks of the accessory companies which are supposed to enjoy the patronage of the rejuvenated master of motordom.

But the buoyancy created by the interest in the Ford, which has been so carefully built up to such an extraordinary climax, will be fleeting unless it stimulates business as much as it has excited the newspaper headlines and speculative enthusiasm. The new car has been heralded by thousands of columns of newspaper articles, and by an advertising campaign which involved the publication of five successive pages in as many issues of two thousand daily papers. No other industrial product has ever received a tenth of this notice, and if publicity can beget activity, the effect ought to be most stimulating.

It is believed that not only will wage disbursements and expenditures for material by the Ford company and its sources of supply increase greatly, but that deferred buying will go to other automobile producers and that the industry will enjoy a renascence of activity that will break all records for output in 1928 and in turn will stimulate other laggards, notably iron and steel. It remains to be seen whether the anticipated revival will follow when the Ford company is again in full production. If it does not, there will be great disappointment, but optimism prevails.

The advance in securities is the more impressive because the rate for call loans on the Stock Exchange, which had been 3½ per cent for a month, rose last week to 4½, later receding to 4, and most of the signs point to slightly firmer money in December coincident with the usual holiday demand for gold and currency. Gold is still being shipped abroad and the rise of Dutch guilders and sterling exchange so close to the "gold point" suggests that more may be lost before the movement ends. But gold movements no longer seem to arouse much interest. Their impact on the money market is so carefully cushioned by the Federal Reserve banks, which build up the supply of credit by purchasing acceptances and government securities, that no shock is felt. The real cause of higher interest rates, if they come, will be increased commercial demand for funds, and as this presupposes greater business activity, the outcome in the stock market should be a tug-of-war between larger earnings and dearer money, which the precedents indicate money would eventually win.

Distributive trade is below last year's levels, as the decline in car loadings shows. They have lately been about 10 per cent less than the comparable figures for 1926, and October rail earnings were 8 to 10 per cent smaller. Wholesale business is less, particularly in textiles, but there are no indications that retail trade has fallen off much or that the sale of holiday goods will not be as enormous as usual.

This picture is not discouraging, either for the present or the future; and while the existence of many "sore spots" and conditions under which the conduct of business is difficult—and making satisfactory profits impossible—must be recognized, they should not blind us to the fact that the forest is larger than the trees.

In Europe the game of alliance and counter-alliance, of dynastic and political dispute, has produced a series of fresh crises whose gravity it would be a mistake to minimize. Paradoxically, the proposal of Russia to abolish armies and navies is more likely to add to than allay them—as indeed it may have been intended to do. But the insensibility of American business to these disputes has often formed the onclusion of these letters, and whether it is deplorable or not it is a condition which adds to our stability.

WHAT'S DOING IN INDUSTRY

THE MOST important feature of the week's industrial news is the long-awaited introduction of the new Ford car. Its effect on the machinery and machine tool trade is expected to be in the nature of a tonic, in that it will influence some substantial equipment orders by the automobile, accessories and parts manufacturers. Outside of this one bright spot, the market is rather colorless.

DETROIT already reports signs of awakening as motor car manufacturers begin to plan new production schedules. Chicago is slow but much is looked for soon from automotive and railroad buyers. Persistent sales effort is keeping the market in Cincinnati from getting too sluggish. Slow but satisfactory improvement is noted in Milwaukee, and Cleveland sees renewed activity on the part of auto and parts makers.

EASTERN New England reports general conditions slightly unsteady, while the Western section sees prospects in a number of programs for equipping trade and technical schools. Closings of pending business are keeping the New York market steady. In Buffalo business is better than in the past two months and prospects are good. General conditions in Philadelphia are uncertain but great hopes are placed in expected railroad business.

THE PAST week brought announcements of approximately 10 per cent price advances in milling machines and in cylindrical grinders. The movement is expected to include all manufacturers of those types of machine tools.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

BUFFALO

Favorable conditions which prevailed during the middle of November in machine tool and equipment trade will apparently continue until late December. One dealer reported business better than at any previous time this year. This report was exceptional but significant. In the electrical industrial equipment field conditions are not as good as in machine tool field, and no real improvement in this phase of business is expected until after the New Year. One manufacturer's representative reported he did not expect any real improvement until February. Conditions may be characterized as quiet. Business is dull in the contractor's equipment field.

NEW YORK

Business placed in the first week in December would seem to indicate that there will be spasmodic closing of pending quotations for at least the first half of the month. Radial drills, jig borers, centerless grinders and high production, automatic milling machines and lathes are represented in the current demand.

There is a better activity in the sale of small bench machines and electrically driven hand tools. Building and industrial construction has helped this demand.

The used tool market is reported to be sluggish, a surplus of good machinery being on hand. Prices are attractive and competition is keeping them within range.

No inquiries of importance have been received by local dealers or agents. There are still some good railroad inquiries pending which are expected to close before the end of the year.

PHILADELPHIA

The trend of business in the machinery and machine tool market in Philadelphia showed little change this week. One company producing equipment for testing steel reported there was a slight upward movement, but the volume was not such that it was possible to ascertain whether it will continue or whether it was only of a temporary nature.

The general industrial situation as reported by equipment dealers and producers is still uncertain. Producers of machine tools for railroads were interested in reports from Washington that leaders in Congress plan to forward the railroad consolidation legislation, as the feeling is that the carriers are holding off purchases until the merger plans become more definitely settled.

CINCINNATI

The majority of machine tool manufacturers in the Cincinnati district report that business has been rather sluggish in the past week. There are some, however, who report that they had a very fair demand, and taking the industry as a whole it seems to have held its own. Selling agents report that by hard and persistent work they are keeping sales at a fair level, at least equal to that of the corresponding season of last year.

No large orders are reported as having been booked in the past week, business being sustained almost entirely by purchases of single tools and replacements, made by general machinists and miscellaneous users. Purchases of railroads, automobile manufacturers and other large users were confined to single tools and replacements. The immediate placing of orders in many cases, it is stated, may be attributed to the desire to come under outstanding quotations.

Manufacturers state that inquiries came in freely during the week, from all sections of the country and for all varieties of tools. Selling agents report that a satisfactory number of prospects are developing.

CLEVELAND

Renewed activity was noted during the closing days of November. Henry Ford's formal announcement of the new car had a stimulating effect on the local machine tool industry. Now that volume production appears to be close at hand, industrial activity is expected to pick up in many auto parts plants where operations have been light for several months.

It is estimated that Ford will spend close to one hundred million dollars for parts in the Northern Ohio district. Among the major contracts let out by Ford to date is a $10,000,000 contract with the H. H. Timken Co., of Canton; a $20,000,000 contract to the Midland Steel Products Co., Cleveland; $2,000,000 contracts with the National Acme Co., and the Cleveland Hardware Co.; and several smaller contracts with various parts manufacturers. Approximately $50,000,000 will be spent for tires in the Akron district.

CHICAGO

Business in machine tools for the last week has remained practically on the same level as last reported. Sales are slow, and of minor importance, consisting principally of individual tools, with here and there a small lot. Machinery men when questioned with respect to prospective trade almost unanimously express themselves as not looking forward to any particular activity until after the holidays and the taking of inventories.

There is a strong and persistent feeling, however, that the first three months of 1928 will witness a marked revival in the machine tool industry, and that with the issuance of new lists by such railroads as are now preparing next year's budgets, a period of activity will be ushered in that will continue at least until midyear.

MILWAUKEE

New business in metal working equipment continues to develop rather slowly, although the character of inquiry strengthens the conviction that there is a large volume of deferred business awaiting an opportune time for release. For the present, however, shops appear to be content to buy nothing more than absolutely necessary, and while the volume of replacement business is moderate, the general situation lacks the elements that usually produces active demand.

Not much improvement is looked for until after January first, due to the fact that automobile factories will require some time to effect readjustments made necessary by the recent developments in their situation as a whole, and an upturn in general business must come before metal working and other factories find reason for full use of their existing capacity.

The dearth of new industrial construction continues to be a limiting factor in the call for tools and machinery. With a few exceptions, foundries and machine shops are experiencing no strain on capacity which would require immediate relief by extensions, and which naturally would require additional equipment.

DETROIT

The machinery market in Detroit has shown some slight favorable reaction to the announcement of the new Ford car, but thus far the effect has not been heavy. A large number of inquiries have come in from many automobile companies and one or two of them are expected to place some good-sized orders this week.

Ford has made inquiries on a large amount of standard equipment to be used in production and the deal on these machines will probably be closed within a few days. He has also made inquiries for 100 grinders. Chevrolet is showing some activity both in the Flint and Toledo factories. Some buying is being done and more is anticipated.

October was a better month here than many of the dealers believed it would be but November was poor. Most of the trade expects December to be normal or below, but all of them look for a large volume of business after the first of the year.

EASTERN NEW ENGLAND

While detailed statistics for the month of November were not available, this section of New England shows an average gain over the month of October of between 2 and 5 per cent in the number of transactions in machine shop supplies. Also, the average closings on inquiries proved to be slightly better than last month, although during the past week there has been a noticeable falling-off in buying.

Machine tools give the impression of steadiness; most sales are confined to heavier pieces. Closings on old inquiries show a slight increase over last week, and the average for the month is on a par with that for October. However, some houses report business as unsteady.

WESTERN NEW ENGLAND

The machine tool and machinery situation in this section underwent little change in the past week. Manufacturers anticipate further reductions in orders before the new year. Desirable inquiries are less in evidence and buyers are not expected to close contracts this year for the better lists. Dealers are doing a worthwhile business in single items for replacements.

Woodworking machinery producers report an improved tone to their business. A notable increase in inquiries resulting in more orders has followed a protracted period of dullness.

Construction plans in progress indicate future machine tool and machinery sales. Manual training in proposed schools at Fall River, Providence, Worcester, Hartford and a boys' club in Bristol, will require about twenty shops to be equipped with drills, lathes, woodworking machinery and numerous small tools.

Heat-Treating Conference in Connecticut

Electrical heat in the heat-treatment of metals, as compared with other methods, was the principal theme of the Conference on Industrial Electrical Heat-Treatment held jointly by the Manufacturers' Association of Connecticut and the Electrical Engineering Department of Yale University, at New Haven, Conn., on Nov. 30. More than two hundred attended the conference, and papers were presented by experts from a number of industrial plants as well as by members of the staff of Yale University. At the dinner held at the New Haven Lawn Club, E. Kent Hubbard, president of the manufacturers' association, told of the objects of the joint research committee which the association maintains together with Yale University. He cautioned manufacturers against hasty changing over of their plants to electrical heat-treatment without due research and consideration of their particular problems, as in many cases their position or other factors might make the continuance of other forms of heat advisable.

In the opening paper of the conference, Professor Chas. F. Scott summarized the situation in regard to electrical heat-treatment. Among the advantages cited by him were: More convenient and accurate temperature control; uniform liberation of heat to the charge; uniform distribution of heat to avoid hot spots; constancy of radiation that is impossible to obtain in fuel furnaces where the path of the gases if affected by the disposition of the material being treated; lower labor costs; and decreased maintenance.

Papers at the morning and afternoon sessions were: "How Electricity Heats and Its Control," by W. B. Hall, assistant professor; "From Guess to Science in Heat-Treatment," by Professor C. H. Mathewson; "Electric Furnaces for Heat-Treating," by Wirt S. Scott, special representative of the Westinghouse Electric and Manufacturing Co.; "How Electric Heat Affects Production Costs," by C. L. Ipsen, engineer, General Electric Co.; "Labor Savings Resulting from Continuous Automatic Electric Furnaces," by R. E. Talley, president and chief engineer, George J. Hagen Co.; "Equipment and Methods of Heat-Treatment at Dodge Brothers," by H. E. Martin, assistant metallurgist, Dodge Brothers, Inc.; "Electric Annealing of Stillson Wrench and Other Forgings," by John J. Harman, research engineer, the Walworth Company.

At the evening session A. H. D'Arcambal, consulting metallurgist, Pratt & Whitney Co., spoke on the hardening of small tools, and outlined the advantages in better product, cleaner and healthier working conditions, and decreased scrap obtained at the Pratt & Whitney plant by the use of lead baths electrically heated, for the heat-treatment of small tools.

Mr. Hubbard, president of the manufacturers' association told the conference that his organization now represents 800 of the leading manufacturers of the state, with a total capitalization of $700,000,000. The research committee, consisting of five members representing the manufacturers and five members of the Yale engineering faculty, was organized four years ago and is a distinct recognition by Connecticut manufacturers of the need for technical education and research for advancing manufacturing methods. The work of the committee combines the laboratories and scientific knowledge of the University with the resources and practical engineering of the industrial plants, and the committee is constantly attacking with success the various manufacturing problems of the association. In speaking of this particular problem of production heat-treatment, Mr. Hubbard pointed out "that combustion methods of heating are constantly improving, and that before entering blindly into any situation, the individual manufacturer must give due thought to the section of the country where he is located, to the particular heat-treatment which he needs, and to the general conditions which surround his problem."

Prizes Awarded for Simonds Essay Contest

William B. Turner, of Twin Falls, Idaho, has been declared the winner of the principal prize of $1,000 in the fifth annual economic essay contest conducted by Alvan T. Simonds, president of the Simonds Saw and Steel Co., of Fitchburg, Mass. Miss A. L. White, of New York City, received an award of $250 as one of the second prizes for her essay on "Saving and Spending as Factors in Prosperity"; and the other second prize was won by Frederic E. Lyford, of Waverly, N. Y., for his essay on "Simplification and Standardization in Relation to Saving."

Mr. Turner was formerly superintendent of the Spokane, Wash., schools and later the head of the Spokane County schools. Miss White is a special writer of foreign trade and business articles for business papers. Mr. Lyford is a mechanical engineer, and supervisor of apprentices in the shops of the Lehigh Valley Railroad at Sayre, Pa.

Steel Treaters Meet

Problems confronting steel treaters in the pickling process and in the hardening room, and methods of increasing efficiency in all parts of the plant were discussed at the recent meeting of the Indianapolis Society for Steel Treating by E. W. Eseau, of Philadelphia, metallurgist for the E. F. Houghton Co. Approximately 150 attended the meeting. The next meeting, it was announced, will be held on Dec. 12 at the plant of the Diamond Chain & Manufacturing Co.

World Industrial Museums Shown in Film

In order to show American audiences what can be accomplished by industrial museums, the trustees of the Museum of the Peaceful Arts in the City of New York have had made three moving picture films of the four great industrial museums of Europe. The film was shown for the first time to a group of New York business men and industrialists on Nov. 29. It was made under the personal direction of Charles T. Gwynne, vice-president of the Chamber of Commerce of the State of New York and one of the trustees of the museum. The museums whose buildings and exhibits were filmed are the Science Museum, London; the Conservatoire des Arts et Metiers, Paris; the Deutsches Museum, Munich; and the Technisches Museum, Vienna.

The principal film, entitled "Museums of the New Age," shows how the interest of the public, as well as of technical men and students, can be aroused in a display of progress of the useful arts. Point is made, through the captions, that such a museum fits well into the scheme of modern education because science and industry play such an important part in present day life. That thought is also implied in the caption of the film, "Museums of the New Age."

In the film itself an effort is made to show the great variety of subjects covered by these museums, and, then, the kinds of exhibits through which the progress of the art is presented. In general, the film gives an excellent idea of the function and working of these great industrial museums.

The films will be used by the trustees to show to groups of manufacturers whom they desire to interest in the museum project. It is proposed to erect a large industrial museum in New York, and it is the expectation of the trustees that they will have available soon a bequest from the will of Henry R. Towne to the extent of about $2,500,000. The City of New York has virtually agreed to donate a site for the museum.

Welding Symposium at Boston

A symposium on welding under the auspices of the Affiliated Technical Societies of Boston will be held on Dec. 14 in Chipman Hall, Tremont Temple, Boston. There will be three sessions. The morning will be devoted to papers and discussions on industrial welding, while the afternoon will be given over to pipe welding. A session in the evening will cover structural and special forms of welding.

At noon the members will attend a luncheon in the Boston City Club, under the auspices of the New England Waterworks Association. The annual engineers' dinner will be served at the same place in the evening.

Management Discusses Employee Influence

Employee representation in the management of industry was the subject of a two-day conference at the Benjamin Franklin Hotel, Philadelphia, on December 1 and 2. The sessions were of a semi-private nature, officials of many industries speaking frankly on the subject, telling of their experiences in admitting representatives of their workers to conferences and in the establishment of co-operative conditions which have resulted beneficially to both workers and management.

Many of the speakers declared their labor turn-over has been reduced as the result of this co-operative effort and that additions to the compensation of the employees has made it worth while from their standpoint. One of the speakers said that when buying in one of his firm's foreign markets fell off and showed signs of early disintegration the management arranged with the employees to work toward recovering the trade without immediate extra pay, but with the understanding that 75 per cent of the profits from that particular market would be divided among the employees. They accepted the proposal and the plan was a success.

The thought was conveyed during the discussions that the natural advancement in the art of management calls for the representation of employees at joint meetings at stated intervals. The various methods of arriving at programs and of committee representation were discussed. It was said that employee representation not only establishes contact between employee and employer, but that such a program begets confidence on both sides.

C. S. Redding, treasurer and factory manager for the Leeds & Northrup Co., presided at the first day's session. The speakers included E. K. Hall, vice-president of the American Telephone and Telegraph Co.; H. Gilbert Francke, Pacific Mills; Harvey G. Ellerd, of Armour & Co.; and Dr. Alfred E. Shipley, personnel director of the Knox Hat Co.

At the afternoon session F. L. Sweetser, general manager of the Dutchess Manufacturing Co., presided, and the speakers were Franklin G. Cover, director of sales promotion, Borden's Farm Products, Inc., T. H. A. Tiedmann, of the Standard Oil Co. of New Jersey, and Bernard J. Mullaney, vice-president of the Peoples Gas Light & Coke Co.

At the morning session on Dec. 2 Ernest T. Trigg, president of the John Lucas Co. presided. The speakers were W. F. Knoll, superintendent, James Pender & Co., Ltd.; W. F. Doherty of the Bethlehem Steel Corporation; W. C. Ruegnitz, president of the Loyal Legion of Loggers and Lumbermen; Rinaldo A. Lukens, of the Continental Mills Co., Inc., and Dr. William M. Leiserson, professor of economics, Antioch College.

At the luncheon at noon of the second day's session, M. E. Leeds, president of Leeds & Northrup Co., presided, and C. S. Ching, of the United States Rubber Co., spoke. This was followed by a session of the conference at which Milton D. Gehris, vice-president of the John B. Stetson Co., presided, the speakers being Harold D. Porter and Howard L. Fitch, both of the Bell Telephone Co., and A. T. Kearney of Swift & Co.

Personals

PAUL RENFREW, of the research department of S. F. Bowser & Co., Fort Wayne, Ind., has been elected secretary-treasurer of the Fort Wayne section of the American Society for Steel Treating.

G. C. BARRY has resigned as assistant to the vice-president in charge of sales for the Brown Boveri Electric Corporation. He is now associated with the Arrow Electric Co., of Hartford, Conn.

R. B. SMITH, formerly chief of standards of the Chevrolet branch at Flint, has been made general superintendent of the Oakland and Pontiac plants at Pontiac. Edward Neubacher, his assistant, was promoted to the position he vacated.

WILLIAM BAUSCH, secretary of the Bausch & Lomb Optical Co., of Rochester, N. Y., was the guest of honor at a testimonial dinner given by the Rochester Club in recognition of his twenty-fifth anniversary as president of the club.

B. W. DEGUICHARD has been elected president of the AC Spark Plug Co., of Flint, Mich. For the past several years Mr. deGuichard has been vice-president and general manager of the company. He succeeds the late Albert Champion, who died in Paris.

WALTER TROOP, formerly sales manager of the North & Judd Manufacturing Co., New Britain, Conn., and connected with that company for many years, has resigned and assumed new duties as vice-president of the O. B. North Co., Inc., New Haven, Conn., hardware manufacturer.

WILLIAM H. WOODIN has been elected president of the American Locomotive Co., succeeding the late F. F. Fitzpatrick. Mr. Woodin has been chairman of the board, and previously had been president. He is also president of the American Car and Foundry Co.

J. L. OVERLOCK has been appointed treasurer of the Studebaker Corporation. Mr. Overlock succeeds N. R. Feltes, resigned. In his new capacity, Mr. Overlock also will be treasurer of the Studebaker Corporation of America and the Studebaker Corporation of Canada, Ltd.

Obituaries

CARLETON A. CHASE, former president of the Syracuse Chilled Plow Co., died in Philadelphia on Nov. 16. He was at one time vice-president of the National Founders Association.

ARTHUR F. BLASDELL, formerly works manager of the General Electric Co., at Pittsfield, Mass., died suddenly on Nov. 27 at Santa Ana, Calif. Mr. Blasdell was 56 years old. Mr. Blasdell resigned his position at Pittsfield December 20, 1926, after 16 years as works manager of the plant.

HARRIS WHITTEMORE, president of the Eastern Malleable Iron Works and a noted manufacturer in other lines, died on Nov. 29 at his home in Naugatuck, Conn., following an illness of two weeks. Mr. Whittemore was 62 years old. Besides being president of the Eastern Malleable Iron Works, he was treasurer of the Bristol Platts Mills, a director of the Landers, Frary & Clark Co., the American Hardware Co., and president of J. H. Whittemore Co. Mr. Whittemore was also connected with the National Malleable Castings Co., the Eberhard Manufacturing Company, and the Link-Belt Co.

Business Items

The Hazard Wire Rope Co., of Wilkes-Barre, Pa., has acquired the rope division of the Waterbury Co., of New York. The production facilities of the two organizations will be consolidated at Wilkes-Barre.

Scully, Jones & Co., manufacturers of production tools under the trade name "Wear-Ever," have moved into a new plant at 1901 Rockwell St., Chicago. The new shops afford additional manufacturing facilities and efficient plant layout.

Herbert R. Isenburger, Inc., of 63 Park Row, New York, announces that it has established an X-ray service for fault analysis and research of materials. Ancel St. John, consulting physicist on X-rays, has been engaged to supervise this work.

Joseph T. Ryerson & Son, Inc., of Chicago, have taken over the exclusive sale of Glasgow iron billets to the railroads of this country. These iron products are made by the Glasgow Iron Co., of Pottstown, Pa., which was organized in 1876 and is one of the oldest in the iron and steel industry.

The C. C. Smith Boat Works at Algonac, Mich., makers of Chris-craft motor boats, has launched another industry. The officers have formed the C. C. Smith Engine Co. and have begun the production of their own motors.

The Ziv Steel and Wire Co., of Chicago, announces a change in its executive control. The new officers are: G. F. Ziv, president; A. Ziv, chairman of the board; N. J. Hyslip, vice-president; M. Foley, secretary, and H. E. Ziv, treasurer. A. F. Brunck has been appointed sales manager with headquarters in Chicago.

The Gilby Wire Co. announces that it will move into its new plant on Riverside Ave., Newark, N. J., during December. The plant consists of three modern buildings situated between the Riverside and Woodside stations on the Erie R.R. The company manufactures resistance wires, fine and flat wires.

The Robert Linn Foundry and Machine Works, of Chicago, has purchased the plant and equipment of the old Crawford & McCrimmon Co., manufacturer of woodworking machinery at Brazil, Ind., and will have the plant in operation soon. The company will manufacture roller bearings for trucks and other railroad equipment.

Forthcoming Meetings

American Society of Mechanical Engineers. Annual meeting, Engineering Societies Bldg., New York City, Dec. 5 to 8. C. E. Davies, assistant secretary in charge of meetings, 29 West 39th St., New York City.

National Exposition of Power and Mechanical Engineering. Sixth annual event in the Grand Central Palace, New York, Dec. 5 to 10. Charles F. Roth, manager, Grand Central Palace, New York City.

Affiliated Technical Societies of Boston. Welding meeting, Chipman Hall, Tremont Temple, Boston, Mass., Dec. 14. J. B. Babcock, secretary, 715 Tremont Temple, Boston.

American Association for the Advancement of Science. Second Nashville meeting, Nashville, Tenn., Dec. 26-31, general headquarters Andrew Jackson Hotel. General chairman, W. S. Leathers, M.D., professor of preventative medicine and public health, Vanderbilt Medical School, Nashville, Tennessee.

Foundry Equipment Manufacturers' Association. Annual meeting, Feb. 7, 1928, Cleveland Hotel, Cleveland, Ohio. H. Cole Estep, secretary, 1213 Third St., Cleveland.

American Society for Steel Treating. Semi-annual meeting, Montreal, Canada. Feb. 16 and 17, 1928. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

AN UPWARD movement in current prices of fabricated brass and copper, solder, genuine highest grade babbitt metal, scrap copper and brass, iron and steel scrap, and wire nails, follows the recent advance in quotations on the three principal hot-rolled steel products. Bars, shapes and plates, base, Pittsburgh, are $1.80 per 100 lb. in large tonnages, with a range of $1.85 to $1.90 per 100 lb., f.o.b., Pittsburgh, applying on smaller lots. Prices continue weak with downward trend, in black and galvanized steel sheets, linseed oil, coke, pig iron, tin plates, wire products other than nails, and strip steel.

(*All prices as of Dec. 2*)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$21.44
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.62
BIRMINGHAM	
No. 2 Foundry	16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	21.26
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	22.80
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50@4.75
Cleveland	5.00
Cincinnati	4.30
New York	4.75@5.25
Chicago	4.75@5.25

SHEETS—Quotations are in cents per pound in various cities rom warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.15	3.50	3.25	3.89
No. 12	2.15@2.20	3.55	3.30	3.94
No. 14	2.20@2.25	3.60	3.35	3.99
No. 16	2.30@2.35	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.55@2.70	3.75	3.55	4.00
No. 22	2.70@2.85	3.90	3.70	4.15
No. 24	2.75@2.90	3.95	3.75	4.20
No. 26	2.85@3.00	4.05	3.85	4.30
No. 28	3.00@3.25	4.20	4.00	4.45
Galvanized				
No. 10	2.90@2.95	4.10	3.80	4.25
Nos. 12 to 14	3.00@3.05	4.20	3.90	4.35
No. 16	3.10@3.15	4.30	4.00	4.45
No. 18	3.25@3.30	4.45	4.15	4.60
No. 20	3.40@3.45	4.60	4.35	4.75
No. 22	3.45@3.50	4.65	4.40	4.80
No. 24	3.60@3.65	4.80	4.50	4.95
No. 26	3.85@3.90	5.05	4.75	5.20
No. 28	4.10@4.15	5.30	5.00	5.45

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to.30 carbon, at warehouse in lots of less than 100 ft. or 100 lb.:

Thickness — Decimal	B.w.g. and Fractions	Outside Diameter in Inches — ¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	....	4.65
Spring steel, heavier	4.00	....	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	5.70	6.10
Floor plates	5.25	5.30	5.00
Cold drawn, round and hex.†	4.00	3.65	3.60
Cold drawn, flats and squares	4.50	4.15	4.10
Structural shapes	3.34	3.00	3.10
Soft steel bars	3.24	3.00	3.00
Soft steel bar shapes	3.24	3.00	3.00
Soft steel bands	3.99	3.65	3.65
Tank plates	3.34	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, ⅛", 8.35c.; ¼, 7.85c.; ⅜" to ½, 7.35c. per lb. *Flat, ⅛"@¼-in. thick. †also shafting and screw stock.

METALS

Current Warehouse Prices in Cents Per Pound for Small Lots

Copper, electrolytic, up to carlots, New York			15.12½
Tin, pigs, 5-ton lots, New York			60.37½
Lead, pigs, up to carlots, E. St. Louis	6.25	New York	7.00
Zinc, slabs, up to carlots, E. St. Louis	5.85	New York	6.75

	New York	Cleveland	Chicago
Antimony, slabs, ton spot	13.25	14.00	14.25
Copper sheets, base	22.25	22.50	22.50
Copper wire, base	18.75	19.50	15.50*
Copper bars, base	21.75	22.00	22.00
Copper tubing, base	24.00	24.50	24.25
Brass sheets, high, base	18.25	18.50	18.50
Brass tubing, high, base	23.12½	23.37½	23.37½
Brass rods, high, base	16.00	16.25	16.25
Brass wire, high, base	18.75	19.00	19.00

*Mill

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	24.37½@25	26@27	26.02
Zinc sheets (casks)	11.00	11.55	10.11½
Solder (½ and ½), (case lots)	36.25	37.50	34@38

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	76.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.50

Nickel, f.o.b. refinery, cents per lb.:
Ingots..... 35.00 Electrolytic.. 37.00 Shot.....36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Full finished nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	45.00
Cold drawn rods, Grade "A" (base)	53.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	28.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Full finished sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible copper	11.87½@12.12½	11.00	10.00@10.50
Copper, heavy, and wire	11 37½@11.87½	10.75	9.75@10.25
Copper, light, and bottoms	10 12½@10.37½	9.50	8.75@ 9.25
Heavy lead	5 00 @ 5.25	5.25	4.50@ 5.00
Tea lead	4.00 @ 4.25	3.75	3.50@ 4.00
Brass, heavy, yellow	7.25 @ 7.50	7.25	6.75@ 7.25
Brass, heavy, red	9.00 @ 9.50	9.75	8.75@ 9.25
Brass, light	5.25 @ 5.75	5.75	5.75@ 6.25
No. 1 yellow rod turnings	7.25 @ 7.75	7.50	6.75@ 7.25
Zinc	3.25 @ 3.50	3.25	2.50@ 3.00

TIN PLATES—Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9 50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	7.00	7 50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.10@0.13½	$0.16	$0.15@0.20
Cotton waste, colored, per lb.	.09@ .13	.12	.12@.17
Wiping cloths, washed white, per lb	.15½@17½	36.00 per M	.15
Sal soda, per lb	.03¾	.02	.02¾
Roll sulphur, per lb	.027	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots	.79½	.89	.83
Lard cutting oil, 25% lard, in 5 gal. cans, per gal.	.65	.50	.50
Machine oil, medium-bodied (55 gal. metal bbl.), per gal.	.27	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft per inch of width for single ply.			
Medium grade	35%	35%	35%
Heavy grade	30%	30%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%*
Second grade	50–10%	60–5%	50–10%†

*Large quantities, 60%. †Large quantities, 60-10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.04
Brass rods	per lb.	.16	.16	.1637½
Solder (½ and ½)	per lb.	.36½	.36½	.43½
Cotton waste, white	per lb.	.10@13½	.10@.13½	.13@.17½
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.10
Lard cutting oil	per gal.	.65	.65	.55
Machine oil	per gal.	.27	.27	.35
Belting, leather, medium	off list	35%	35%	40–5%
Machine bolts, up to 1x30 in., full kegs	off list	50%*	50%*	40%

*New list April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
*Flint paper	$5.13	$4.95	$5.13
*Emery paper	10.71	9.15	10.71
*Emery cloth	27.84	27.85	27.84
Emery disks, 6 in. dia., No. 1, per 100:			
Paper	1.29	1.27	1.32
Cloth	3.10	3.05	3.05
Fire clay, per 100 lb. bag		.75	.75
Coke, prompt furnace, per net ton		Connellsville,	2.75@3.00
Coke, prompt foundry, per net ton		Connellsville,	3.75@4.50
White lead, dry or in oil,	100 lb. kegs	New York,	13.75
Red lead, dry,	100 lb. kegs	New York,	13.75
Red lead, in oil,	100 lb. kegs	New York,	15.25

*4½ reams and under.

SHOP SUPPLIES

Discounts from new list dated Apr 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Full Kegs or Cases
Machine bolts, square heads and nuts:	
Up to ¾ x 6-in	55%
Larger up to 1 x 30-in	50%
1¼ and 1½ in. dia	35%
Carriage bolts:	
Up to ½ x 6-in	55%
Larger sizes	50%
Coach and lag screws:	
Up to ½ x 6-in	55%
Larger sizes	50%
Tap bolts, hexagonal heads	40%
Nuts:	
Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl	55%
Cold punched, square and hexagonal, blank or tapped, up to 1-in, incl	55%
Semi-finished, hexagonal, tapped, in packages, all sizes	40%
Case hardened, hexagonal, tapped, in packages, all sizes	30%
Washers: Deduct from list, per 100 lb	$3.50*
Rivets, button and cone head:	
Small, including 7/16-in. dia	50–10%
Large (base) per 100 lb. net	$5.00†

Note—For less than case or keg quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.

*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

Machine Requirements and Industrial Construction

Equipment Wanted

Mass., Lynn—Tougberg Co., 17 Hovey Terrace—punch press, medium size.

Que., St. Lampberts — Monarch Electric Co. Ltd., Waterman St.—machinery and equipment for proposed plant. Estimated cost $75,000.

Mich., Detroit — H. G. Harris Co., 994 Catherine St. (electro plating)—ten d.c. motor driven polishing lathes.

Minn., Alexandria—City—10 ton traveling crane, etc. for proposed addition to power plant.

Opportunities for Future Business

Calif., Los Angeles—Bauman Bros., 6527 McKinley St., is receiving bids for a 2 story, 60 x 165 ft. factory for the manufacture of furniture at St. Andrews Pl. between 63rd and 64th Sts. Estimated cost $75,000. H. K. Boone, Washington Blvd., Culver City, Archt. Noted Dec. 1.

Calif., Redding — State Highway Comn., will soon award contract for the construction of a maintenance yard including blacksmith shop, etc. H. S. Comly, Dist. Engr.

Calif., Los Angeles — Sterling Electric Motors Inc., 120 West 4th St., awarded contract for first unit of factory, 1 story, 100 x 100 ft. Noted Dec. 1.

Ill., Chicago — Advance Pattern Foundry Co., 2734 West 36th Pl., awarded contract for a 2 story foundry at 36th Pl. and California Ave. Estimated cost $250,000. Noted Nov. 17.

Ill., Chicago — Chicago-Motoramp Garages, 38 South Dearborn St., awarded contract for a 10 story, 100 x 150 ft. garage at 62-68 West Lake St. Estimated cost $800,000.

Ill., Rockford—Damascus Steel Products Corp., awarded contract for a 1 story, 60 x 260 ft. factory on Kishwaukee St. Estimated cost $60,000.

Ill., Quincy—Behrensmeyer & Hafner, W. C. U. Bldg., Archts., will receive bids about Jan. 1 for a 1 story foundry for Excelsior Stove Co., W. J. Fisher, V. Pres., 510 South Front St.

Ind., Fort Wayne—Woodward Engineering Co., East Pontiac St., awarded contract for a 1 story, 60 x 100 ft. factory. Estimated cost $60,000.

Ind., Muncie — Warner Gear Co., R. P. Johnson, Pres., awarded contract for the construction of a 1 story, 140 x 180 ft. factory at Pennsylvania and Clark Sts. Estimated cost $50,000.

Mass., Boston—U. S. Government, Post Office Dept., Washington, D. C., will soon award contract for a 3 story 115 x 300 ft. garage here. Private plans. Noted Nov. 24.

Mass., Boston—A. J. Wilson, c/o B. S. Brown, 65 Franklin St., Archt. is receiving bids for a 1 story, repair and service garage at 33 Miller St. Estimated cost $40,000.

Mass., Cambridge (Boston P. O.)—R. C. Grovestein, 5 Brattle St., awarded contract for a 1 story, 75 x 140 ft. repair and service garage on Sparks St. Estimated cost $40,000.

Mass., New Bedford—H. Marcotte, 522 Ashley Blvd., is having plans prepared for a 1 story, 50 x 100 ft. garage and repair shop at Tarkiln Hill Rd. and Belleville Ave. O. Crapo, 1428 Acushnet Ave., Archt.

Mass., New Bedford—Ted-Toy-Lers Inc., 60 South Water St., is having plans prepared for a 4 story, 50 x 100 ft. addition to factory. Estimated cost $60,000. Private plans.

Mass., Roxbury (Boston P. O.)—Chickering & Sons, 791 Tremont St., Boston, awarded contract for a 1 story addition to factory at 18 Station St., here. Estimated cost $40,000. Noted Nov. 24.

Mass., South Boston (Boston P. O.)—Gillette Safety Razor Co., 41 West First St., awarded contract for a 2 story addition to shop at 58 West Second St.

Mass., West Quincy (mail Braintree)—Blue Hill Filling Station, 1230 Furnace Brook Parkway, awarded contract for a 1 story repair and service garage. Estimated cost $40,000.

Mich., Detroit—Book Estate, Book Bldg., is having plans prepared for a 12 story, 100 x 182 ft. garage on Washington Blvd. L. Kamper, 3729 Cass Ave., Archt.

Mich., Detroit — Chrysler Motor Corp., Massachusetts Ave., awarded contract for a 4 story, 60 x 400 ft. engineering building and factory on McLean Ave.

Mich., Detroit—Hudson Motor Car Co., 10617 Knodell Ave., awarded contract for a 3 story, 80 x 100 ft. addition to auto plant. Estimated cost $125,000.

Mich., Lansing — Reo Motor Car Co., South Washington St., awarded contract for a 3 story, 65 x 100 ft. addition to auto plant on South Washington St. Estimated cost $100,000.

Mich., Royal Oak — Grand Trunk Ry. Western System, Detroit, is having plans prepared for the construction of a car repairing plant, engine house, etc., here. J. A. Heaman, Ch. Engr.

Minn., Elk River—Odegard-Hoglund Co., will build a 1 story, 80 x 130 ft. garage at Jefferson Highway and Quincy St., Architect not selected.

Minn., Minneapolis — Kremer Motor Co., 1518 Hennepin Ave., will build a 1 story, 150 x 154 ft. garage at 27th St. and Hennepin Ave. P. E. Crosier, 916 New York Life Bldg., Archt.

Mo., Independence — Gleaner Combine Harvester Co. Inc., manufacturers of combined harvester machines for farms, awarded contract for the construction of a factory. Estimated cost $75,000. Noted Oct. 6.

Mo., Kansas City — Scarritt Estates, Scarritt Bldg., awarded contract for a 2 story, 50 x 125 ft. service station. Estimated cost $50,000.

Mo., Popular Bluffs—Missouri Pacific Ry., Railway Exchange Bldg., St. Louis, Mo., plans yard and terminal improvements. Estimated cost $200,000. E. A. Hadley, Ch. Engr.

Mo., St. Louis—Hemp & Co., 1945 South Vandeventer Ave., manufacturers of heaters, awarded contract for a 2 story factory. Estimated cost $45,000.

N. J., Asbury Park—C. B. Cook, 700 Sixth Ave., Archt., is receiving bids for a 3 story, 100 x 150 ft. garage at Cookman and Munroe Aves. for Asbury Park Hotel, 418 Main St. Estimated cost $500,000.

N. J., Perth Amboy—Huff Airplanes Inc., I. R. Crouse, 497 Division St., will build a 1 story factory at Pardee Tract. Estimated cost $50,000. Greiser & Tuzik, 175 Smith St., Archts. Noted Sept. 1.

N. Y., Utica—Utica Ramp Parking Co., E. D. Lee, Mayron Bldg., plans the construction of a garage at Oriskany, West and Washington Sts. Estimated cost $300,000. Ramp Building Corp., 21 East 40th St., New York, N. Y., Engr.

N. D., Fargo—S. Field, Moorhead, Minn., awarded contract for a 1 story, 100 x 140 ft. garage at Third Ave. and Fifth St. N., here. Estimated cost $40,000. Frosaker-Donovan Motor Co., 56½ Broadway, Fargo, N. D., lessee.

O., Cincinnati—Broadway Garage Inc., 521 Sycamore St., will soon award contract for a 7 story, 150 x 200 ft. garage at 6th St. and Broadway. Estimated cost $500,000. Rendigs, Panzer & Martin, 609 Southern Ohio Bank Bldg., Archts. Noted Dec. 1.

O., Bellefontaine — Bellefontaine Bridge Co., has acquired a site adjoining plant and plans extensions and improvements.

O., Dayton — Leland Electric Co., 218 North St. Clair St., plans the construction of a 2 story, 100 x 200 ft. factory for the manufacture of electric motors and appliances at Leo and Webster Sts. Estimated cost $175,000. Architect not selected.

O., Mansfield — Humphrey Mfg. Co. awarded contract for a 1 story, 50 x 120 ft. foundry and 30 x 120 ft. cleaning room. Estimated cost $50,000.

O., New Comerstown—Heeler Bros. Co., manufacturers of files and tools, plans the construction of a 1 story factory. Estimated cost $40,000 to $50,000.

Pa., Philadelphia—Goldstein Bros., c/o J. E. Fieldstein, Otis Bldg., Archt., awarded contract for a 1 story, 103 x 215 and 115 x 240 ft. garage at Rochelle and Wissahickon Sts.

R. I., Providence—Jewelers Supply Co., Garnet St., is having preliminary plans prepared for a 2 or 3 story factory at Eddy and Ernest Sts. Estimated cost $40,000. C. R. Makepeace & Co., Grosvenor Bldg., Archts.

Tenn., Nashville — Davidson County Highway Comn., F. M. Dorris, Chn., Court House, awarded contract for the construction of a machine shop and garage at 5th and Hitt Sts. Estimated cost $66,650. Noted Nov. 17.

Tex., Houston—Houston Show Case & Mfg. Co., D. D. Orr, Pres., awarded contract for the construction of a 120 x 300, 24 x 200, 68 x 116, and 20 x 28 ft. plant, all 1 story, at Center, Harvard and Waggoner Sts. Estimated cost $200,000.

Wis., Madison—R. M. Koen, 308 Commercial National Bank Bldg., awarded contract for a 1 story, 50 x 136 ft. garage at 1901-20 Winnebago St. Estimated cost $45,000. F. Riley, 24 East Mifflin St., Archt.

Wis., Stevens Point—Joerns Bros. Furniture Co. will build a 3 story, 50 x 60 ft. factory. Private plans.

Manitoba—Flin Flon Mining Co., Mining Corp. of Canada, Winnipeg, plans the construction of a smelter capable of treating 3,000 ton ore per day.

Ont., Niagara Falls — Herbert Morris Crane & Hoist Co., Stanley St., awarded contract for a 1 story, 80 x 160 ft. addition to factory. Estimated cost $50,000.

Ont., Oshawa—General Motors of Canada, awarded contract for a 1 story, 100 x 100 ft. repair shop, etc. Estimated cost $150,000.

Ont., Ottawa — Canada Bread Co. Ltd., 160 Avenue Rd., Toronto, plans the construction of a 1 and 2 story garage on Catharine St. here. Estimated cost $150,000. Architect not selected.

Ont., Toronto — Canadian National Exhibition, Lumsden Bldg., plans the construction of a 1 story automobile building. Estimated cost $900,000. Chapman & Exley, Northern Ontario Bldg., Archts.

Ont., Windsor—Chrysler Corp. of Canada, 300 Tecumseh Rd., awarded contract for a 1 and 2 story, 68 x 80 and 100 x 400 ft. auto factory. Estimated cost $350,000.